THE PAINTER, GILDER, AND VARNISHER'S COMPANION.

COMPRISING

THE MANUFACTURE AND TEST OF PIGMENTS, THE ARTS OF PAINTING, GRAINING, MARBLING, STAINING, SIGN-WRITING, VARNISHING, GLASS-STAINING, AND GILDING ON GLASS; TOGETHER WITH COACH PAINTING AND VARNISHING, AND THE PRINCIPLES OF THE HARMONY AND CONTRAST OF COLORS.

TWENTY-SEVENTH EDITION.

REVISED, ENLARGED, AND IN GREAT PART REWRITTEN.

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Editor of "Varnishes and Lacquers," Printing Inks and Sealing Waxes."

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PREFACE TO THE REVISED EDITION.

As shown by the constant demand for it, *The Painter, Gilder and Varnisher's Companion* still retains the popularity and reputation it has for so many years enjoyed.

The issue of a new edition having become necessary, the book has been thoroughly revised and entirely reconstructed, a very considerable amount of new matter having been added and old matter eliminated, to bring the work up to modern times and make it still more useful to the reader.

In making these additions the aim of the original edition—to give a clear, concise and comprehensive view of the principal materials to be used and the operations to be conducted in the practice of the various branches of the trades treated of—has been constantly kept in view.

Numerous German and English works have been consulted, and special acknowledgments are due to the fourth edition of "Muspratt's Theoretische, Praktische and Analytische Chemie," "Oel und Buchdruckfarben" by Louis Edgar Andés, "Painters' Colours, Oils and Varnishes" by George H. Hurst,

"The Chemistry of Paints and Painting," by A. H. Church, and to other authorities.

The book has also been provided with a copious table of contents and a very full index, which will render any subject easy and prompt of reference.

W. T. B.

PHILADELPHIA, *January 1, 1894.*

CONTENTS.

Tools and Apparatus.

Pigments.

GRINDING AND WASHING COLORS.

COMPOUND COLORS, OILS AND VARNISHES.

PRACTICE OF PAINTING.

Practice of Varnishing and Polishing.

On Lacquering.

THE

PAINTER, GILDER, AND VARNISHER'S COMPANION.

TOOLS AND APPARATUS.

BEFORE entering upon any details respecting the nature, use, and composition of the substances employed by the painter, gilder and varnisher, a description of the tools and apparatus necessary in these occupations, with directions for their selection and proper use, will be given.

Paints are prepared for use by grinding the dry pigments with oil. This is done on a large scale in a color mill, and on a small scale, by means of a *stone slab* and *muller*. To be sure, colors ready for work are sold at the paint shops, but these cannot always be depended on; and further several of the colors, such as lakes, Prussian blue, etc., deteriorate in quality by being kept long after grinding, and it is, therefore, important that these should be prepared by the painter himself.

The *slab* is a flat piece of porphyry, marble, or other

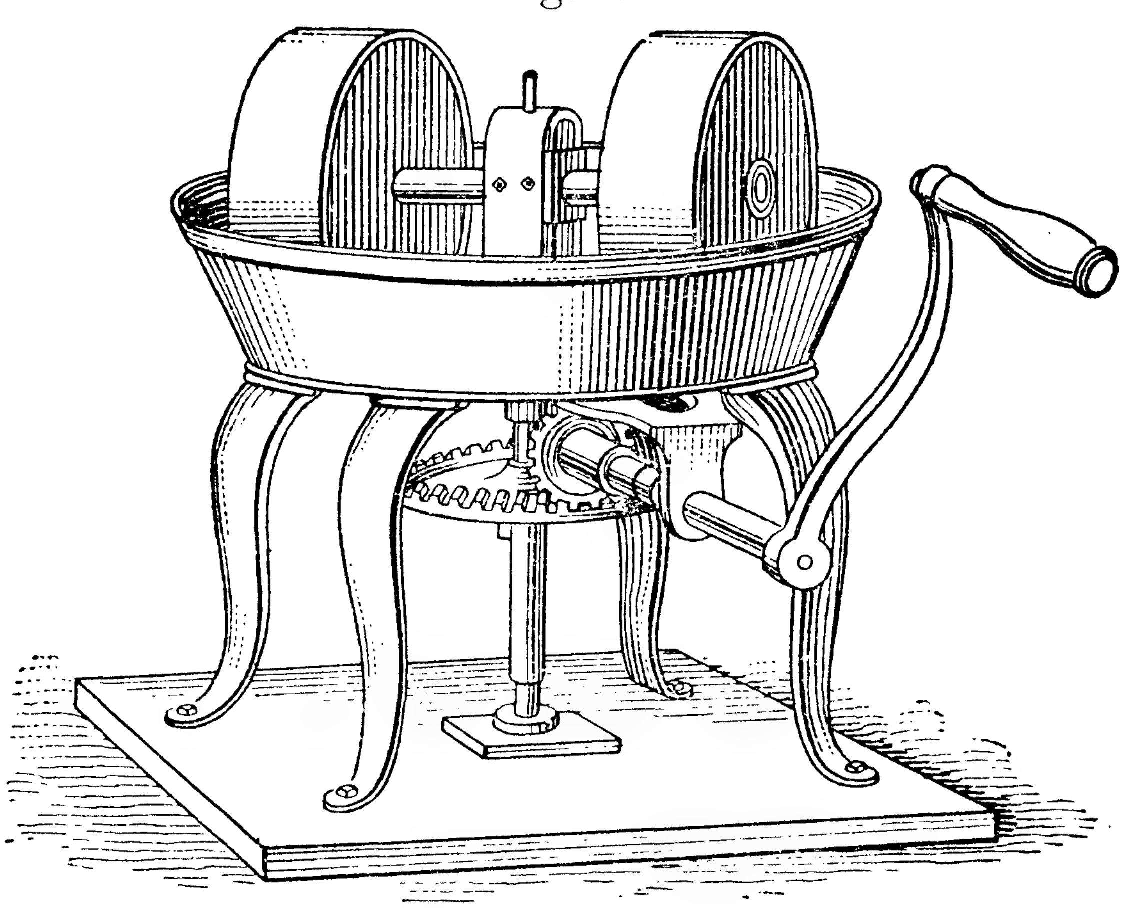
close-grained stone. The *muller* is a semi-ellipsoidal boulder, cut in halves, or flattened at one end. For general purposes it should not be less than four inches across the flat base, and should be of sufficient length to allow of its being grasped by both hands. Where this is not the case, and when the muller does not afford sufficient purchase for the hands, it is apt to tilt over towards the back or front and thus these edges become rounded, and the under surface of the muller becomes curved instead of being perfectly flat.

If the dry pigment is in lumps, and of a brittle character, it should, in the first instance, be pounded in a mortar, and passed through a rather fine sieve. It should then be mixed with a sufficient quantity of linseed oil to form a thick paste. A portion of this is then to be taken on the palette knife, and placed on the slab to be ground by the muller. If, however, the dry pigment is of a very soft character, like chrome yellow, or in powder, like ultramarine, it will not be necessary to employ the mortar, but the pigment may be mixed with oil on the slab by means of the palette knife, and when just saturated the muller may be used. Brittle pigments should, however, never be worked in this way, as they chip under the knife or muller, and great waste and other inconveniences are the consequence.

In grinding the pigment, the muller should be worked towards and from the workman, and also occasionally in a circular direction; but the backward and forward motions are the best, as a certain amount of pressure can better be brought to bear on the pigment, and the flat surface of the muller is better preserved. As the work proceeds the paint should be scraped up by means of the palette knife from all parts

of the slab, to be again brought under the influence of the muller, from the edge of which it should also be gathered. There is no economy in placing a large quantity of color at one time on the slab; a small portion, spread over the whole surface, will form a thin film, and will thus be more quickly and more efficiently ground than a thicker mass. As soon as the quantity of color is sufficiently smooth, it is to be removed, and a further supply placed on the slab.

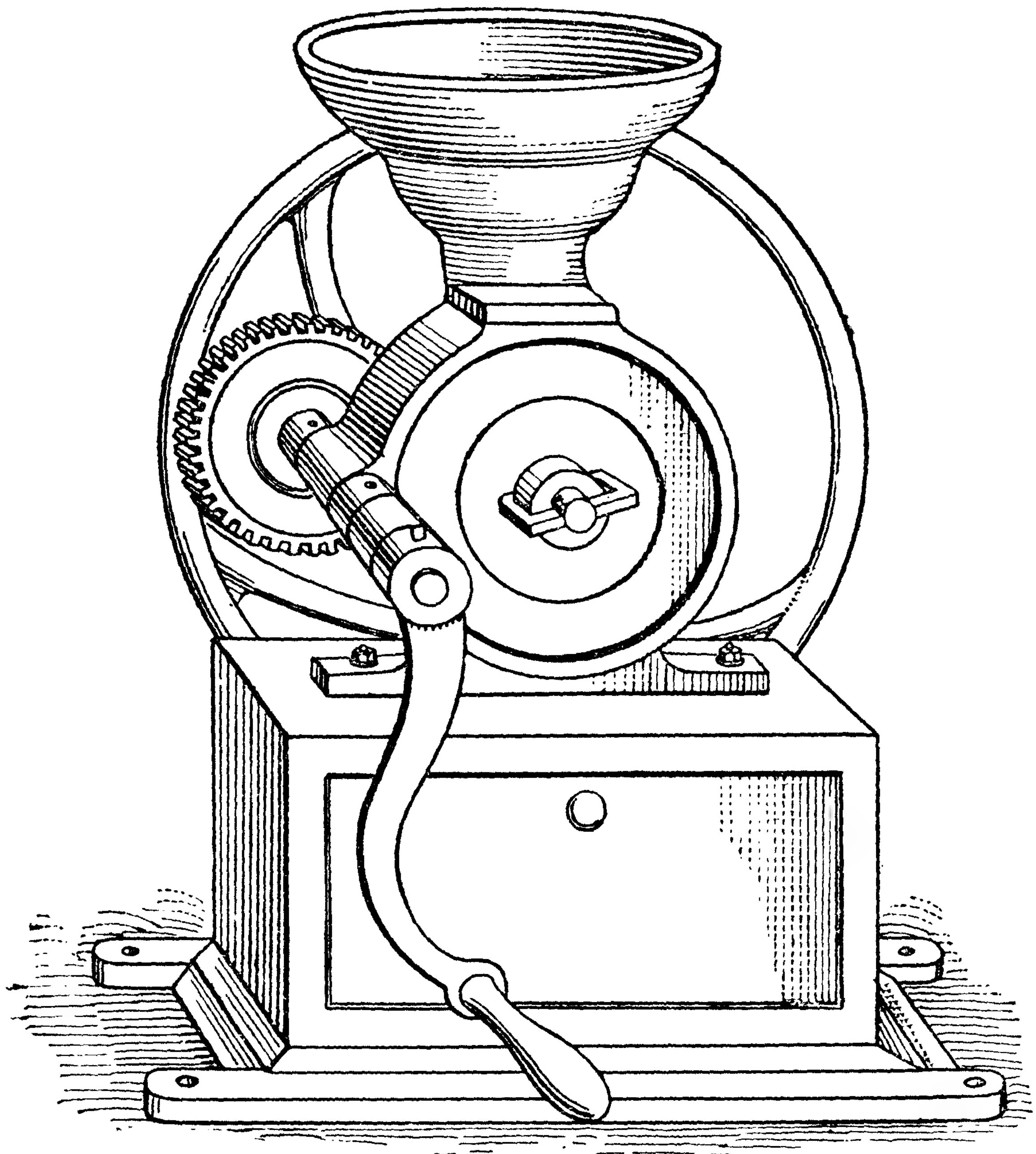
Fig. 1.



Where large quantities of pigments are to be ground, a grinding mill becomes a necessary part of the outfit of a paint-shop. The simplest and oldest grinding mill is the so-called *edge-runner mill*. The essential principle of such a mill is that of a circular stone or runner, set edgeways, and running in a circular basin-

shaped trough, or hopper and bed, on which the material to be ground is placed, and the stone rolling over it crushes it to powder. Fig. 1 shows an edge-runner

Fig. 2.



mill, such as is especially used for color grinding. It is made in several sizes for hand or steam-power. Its capacity will necessarily vary with the character of the material which is being ground. Much, too, de-

pends upon the degree of fineness of the grinding; the finer it is, the smaller will be the quantity turned out.

The cone-mill shown in Fig. 2 is another form of grinding mill. In this mill the top grinding surface is formed by the bottom edge of a fixed hopper, into which the material to be ground is fed. The bottom grinding surface is made of a conical shape, and fits closely against the edge of the hopper. The actual grinding surfaces are portions only of the hopper and cone respectively, and these portions are usually corrugated so as to increase the grinding action, the corrugations starting from the centre and tapering towards the outer edges, to which, however, they do not extend. A screw arrangement under the mill serves to regulate the distances apart of the two surfaces and consequently the fineness of grinding. The material is fed into the hopper, a revolving knife in which serves to keep the materials well mixed together. The ground material passes out from between the surfaces, is scraped off by a suitable scraper, and collects in a box or trough provided for the purpose. This cone mill is made in various sizes, from mills small enough to be driven by hand to those large enough to require power.

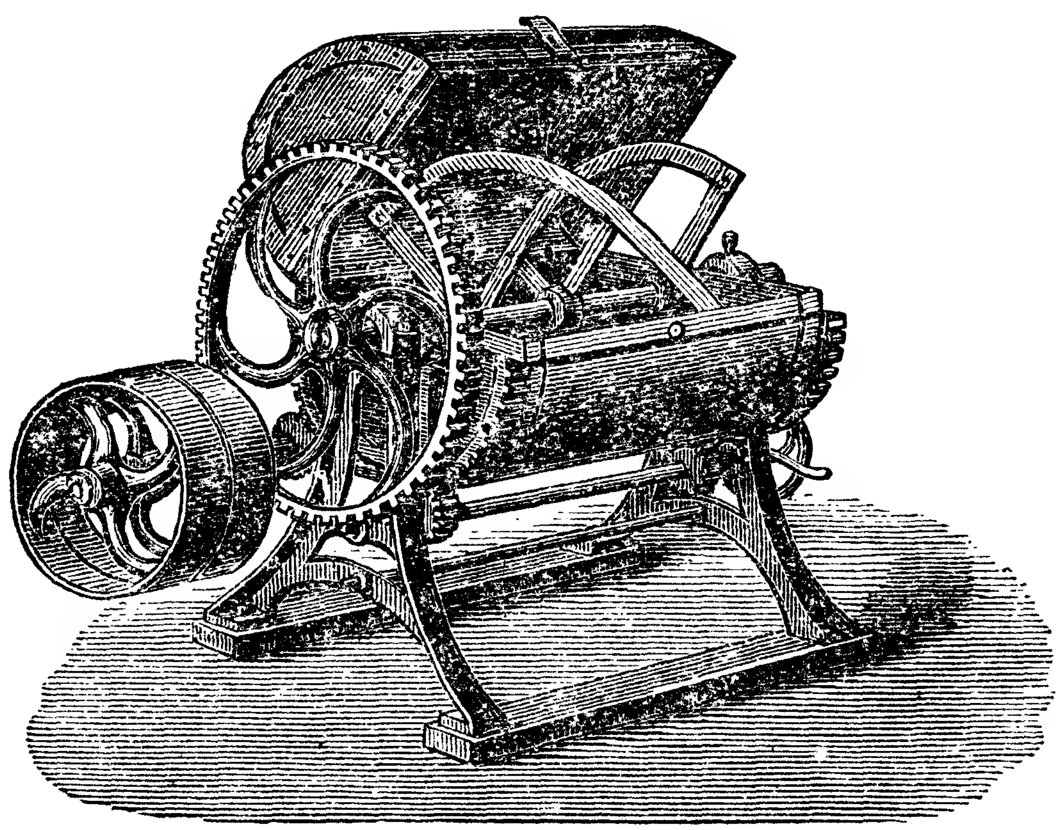
Mixing or Pug Mills. These mills serve for mixing the dry, pulverulent pigments with the oil, either to form the stiff paste in which so much of the painter's pigments is now sold, or to mix the pigment, oil, etc., into paint ready for use.

Fig. 3 shows a mixing or pug mill constructed by J. M. Lehmann, of Dresden, Saxony. The mill consists of a strong iron frame in which rests a cylindrical trough which by means of a cog-wheel gearing revolves around its axis. In the trough itself is the

actual mixing arrangement in the form of segmental, reticulate blades, which in conjunction with the revolving motion of the trough effect an intimate mixture of the pigment and oil.

Roller Mills. These mills are used for grinding colors mixed with oil; they cannot be used for dry colors at all. The principle on which most of them work is

Fig. 3.

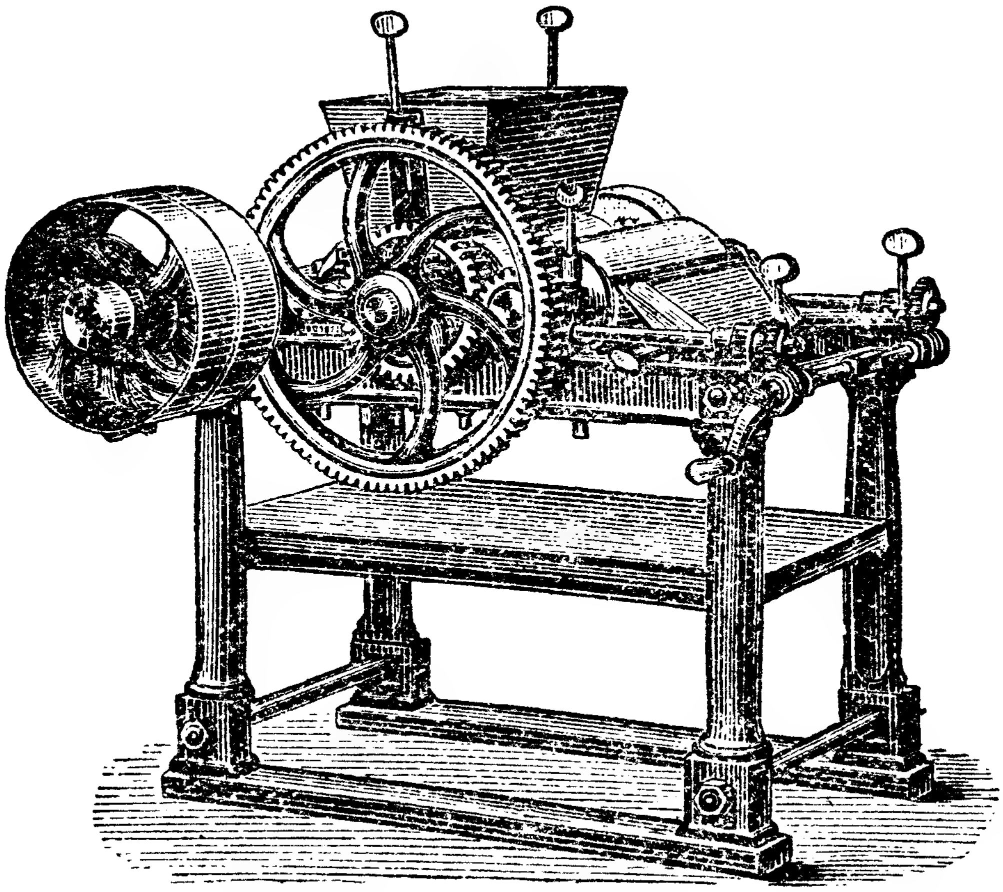


that the color previously mixed with oil, is fed between the first and second rollers, where it gets a first grinding and then, adhering to the middle roller, it is carried around, and again ground between the middle and the last roller; then passing round the third roller, is scraped off by the delivery roller and delivered into a receiver.

Fig. 4 shows a roller mill as constructed by J. M. Lehmann, of Dresden. It is provided with three very

finely polished rollers of green porphyry, which are harder than steel, and possess the property of the color adhering well to them, in consequence of which the finest grinding and greatest capacity are attained. With proper treatment of the mill it is impossible for the color to be forced over the edges of the rollers.

Fig. 4.



The rollers revolve at different speeds and the front roller has besides a lateral motion to and fro.

The quantity of oil required to grind colors into the stiff paste in which they are now generally sold varies considerably with different pigments, some requiring a comparatively small quantity of oil, others a relatively large quantity. The following table furnished by G. H. Hurst will give some idea of the proportions

usually adopted, which are essentially the same both for raw and for boiled linseed oil:

White lead	$7\frac{1}{2}$	per cent.	of oil.
Zinc white	22	"	"
Barytes	7	"	"
Putty	18	"	"
Black	27	"	"
Brunswick green	11	"	"
Red oxides	10	"	"
Brunswick blue	11	"	"
Oxford ochre	$16\frac{1}{2}$	"	"
Burnt Turkey umber	29	"	"
English umber	20	"	"
Vandyke brown	40	"	"
Siennas	$37\frac{1}{2}$	"	"
Black in turps	55	"	of turpentine.

In mixing or thinning paints for use, it must be pointed out that, for outdoor work, boiled oil is principally or wholly employed, unless it be for decorative parts of houses, when a portion of turpentine and pale linseed oil is often added. For indoor work, linseed oil, turpentine, with a small quantity of driers, are generally used in the same way. The smaller the proportion of oil employed for the purpose, the less will be the gloss and the greater the ultimate hardness of the coating. For flatted white, etc., the color being ground in oil requires scarcely any further addition but turpentine, the object being to keep it flat or dull.

Brushes. The painter or varnisher should be very circumspect in the choice of his brushes, because no matter how well skilled he may be, a poor, ill-shaped brush will retard his progress and in a measure spoil his work. There are two very important points to

bear in mind when selecting a brush, viz., is it well made, and is it of good material? A brush to do good, durable service should have good stock in the centre, because whether ground down or chiseled by wear, the centre makes the point. When the point is gone the brush is a stub, and that will soon happen when a brush is filled with short, uneven, inferior bristles.

The brushes used are of various sizes and kinds. The largest are called pound brushes. The large brushes are also termed "four O," "six O," and "eight O," the latter being the largest. These are made both round and flattened, or elliptical. These elliptical brushes are found very convenient in practice, as they take less time to work into the shape required for spreading the paint. Paint brushes are bound either with string or copper wire. They are sometimes used as dusters before being put into oil, by which they become softened. This practice, however, cannot be recommended, for a certain amount of dust necessarily finds its way up the brush, and is liable to work out when it is being used for painting purposes, thus giving the work a coarse and gritty appearance, and causing much annoyance.

The smaller brushes are called *tools* or *sash tools*, and may be obtained in about a dozen different sizes, some bound with string, others fixed in tin. The smallest hog-hair brushes are called *fitches*, and are used for small work where the tools would be too large. The smallest brushes are the *camel's hair*, with long or short hair, according to the work to be done.

The *dusting* brushes have longer hairs than the painting brushes. They are so bound that they spread outward at their points, which are thus prevented adhering, and the dust is more easily shaken from them.

Varnish brushes may be had in different sizes, and also made flat and of different breadths for varnishing pictures and other fine work.

When engaged upon work which will require the use of small brushes for some time—as in painting a narrow moulding or beading—it is customary instead of having the colors in pots or pans, to dispose them in such quantities as they are likely to be wanted in, upon a *palette*. By a marbler and letter painter the palette is employed to the entire exclusion of the paint-pot.

Palettes are made of mahogany, or of satin or other light woods, which are to be preferred to those of mahogany whenever light tints are to be mixed on them. They should be of as little weight as possible, and should diminish in thickness towards their distant end. The oblong form is to be preferred to the elliptical, as it affords more room for colors. New palettes should be prepared for use by rubbing raw linseed oil repeatedly over them until they will absorb no more, the last coat being allowed to dry in, as much as possible, and the palette being then well rubbed, it will not after this be stained by absorption of color.

In connection with the palette the *mahl-stick* has to be mentioned. This is simply a smooth stick, having a ball of wool, covered with a piece of kid or wash-leather, at its end. It is used as a rest for the hand in letter painting or other fine work. It should, therefore, be quite stiff, so that it may not bend under the weight of the hand.

The *palette knife* is a long and very flexible knife, with blunt edges and rounded at the end. As its name implies, it is intended for mixing colors on, or scraping them off from, the palette. In using it, it

should be held as flat as possible, so as to avoid scratching the palette. A similarly shaped implement of larger size is called the *stone knife*, and is used in connection with the slab.

The *stopping knife* is used in stopping cracks, etc., with putty. The knife is shorter in proportion than the palette knife, is spear-shaped, broad and stiff, so as to be adapted to bear the force necessary to press the putty into the crevices, etc. The tools used in graining are described in the chapter relating to that subject.

The *gilder's cushion*, upon which when gilding he places the leaves taken from the book of gold, corresponds with the painter's palette. It is a small board, covered first with baize or cloth and afterwards with wash leather, which is tightly stretched over it. This cushion is supplied with a loop underneath into which the thumb passes, the cushion resting on the hand in much the same way as a palette does. There is also an edging or wall made of parchment on three sides of the cushion, and this in some degree prevents the gold-leaf blowing away.

There are other articles which are desirable or even indispensable for the painter, gilder or varnisher to have among his apparatus, but which do not require special description, such as dusting-cloths, pots and pans of different sizes to hold paints, a large pestle and mortar, hair and silk sieves, square and rule, compasses and black lead pencils.

Filling in and making good all nail holes, bad joints, cracks, etc., with putty forms an important part of the painter's work, and, therefore, a description of the materials used for the purpose and the mode of preparing them may here be given.

Putty may be considered as a cement. The best putty is made from carefully selected fine dry whiting and pure linseed oil or linseed oil varnish, the latter drying more quickly. The whiting should be passed through a sieve, the meshes being forty-two threads to the inch. It is then thoroughly incorporated with the oil. The product has no unpleasant smell, dries readily on exposure to the air, does not turn yellow with age, nor stain yellow through the paint with which it is covered, is easily manipulated and does not harden in closed cans or barrels.

Inferior putties are made from marble dust, which saves oil; cliff-stone sand, which serves the same purpose; putty-powder, of which the constituents vary; fish oil, which has a disagreeable, characteristic odor, and is non-drying; and petroleum oils, which are also non-drying.

The fault induced by the use of coarse or improper bases is the so-called "shortness" or lack of tenacity, which makes the putty break into fragments under the knife. Fish oil, besides its bad odor, has, in common with the mineral oils, the fault of never drying perfectly hard, while the latter, in time, strike through and discolor the paint used over them.

Large masses of putty after being opened should never be allowed to stand exposed to the air without a covering of linseed oil, which excludes the air and prevents hardening. Small quantities should be kept in oiled paper or under water.

A putty which requires to be made as wanted (as it gets hard almost immediately) is composed of red lead in powder mixed with boiled oil and turpentine varnish. It is used for fronts of houses or any place requiring hard putty.

Soft putty. Mix 10 lbs. of whiting and 1 lb. of white lead with the necessary quantity of boiled linseed oil, adding to it ½ gill of the best olive oil. The latter prevents the white lead from hardening and preserves the putty in a state sufficiently soft to adhere at all times, and not, by getting hard and cracking off, suffering the wet to enter, as is often the case with ordinary hard putty.

French putty. Boil linseed oil, 7 parts, with brown umber, 4 parts, for 2 hours; then add chalk, 5½ parts, and white lead, 11 parts, and thoroughly mix the whole. This putty is very durable and adheres well to wood, even though not previously painted.

Facing putty. Mix whiting, white lead and a small quantity of litharge. Then add a small quantity of drying oil. This putty is especially good for stopping small flaws.

Indestructible putty. Boil 4 lbs. of brown umber in 7 lbs. of linseed oil for 2 hours; stir in 2 ozs. of wax; take from the fire, and mix 5½ lbs. of chalk and 11 lbs. of white lead, and incorporate thoroughly.

Lime putty for wood. Rye flour 10 parts, slacked lime 5, linseed oil varnish 5, umber a sufficient quantity to color.

Wood and glue putty. Dissolve glue in water, and add as much very fine saw-dust as may be required.

Putty for floors. Litharge 1 part, plaster of Paris 2, glue 1, water 8, cement 4, saw-dust 2, casein 5, water 30, ammonia 3, burned lime 3.

To soften hard putty. Common putty becomes exceedingly hard with age, which renders the removal of glass from sashes very difficult. The putty may, however, be softened by using a paste of caustic potash, prepared by mixing the caustic potash with equal

parts of freshly burned lime, which has previously been sprinkled with water, so as to cause it to fall into a powder. This is then mixed with water to a paste, and is spread on the putty to be softened. In order to prevent the paste from drying too quickly, it is well to mix it with less water, adding some soft soap instead.

Another process is as follows: Take 1 lb. of pearl-ash and 3 lbs. of quicklime. Slack the lime in water, then add the pearl-ash and make the whole the consistency of paint. Apply it to both sides of the glass and let it remain twelve hours, when the putty will be sufficiently softened to allow of the glass being removed with ease.

Putty may also be softened so that it can be cut out quit eeasily with a knife by rubbing soft soap on it pretty thick and allowing to stand 12 hours or more.

PIGMENTS.

The general qualities of good pigments, technically called colors, are: 1. Beauty of color, which includes pureness, brightness and depth; 2. Body; 3. Transparency or opacity; 4. Working well; 5. Keeping their place; 6. Drying well; and 7. Durability. However, but few pigments possess all these qualities in equal perfection.

Body in opaque and white pigments is the quality of covering and hiding a ground well, but in transparent pigments it signifies richness of color or tinting power. *Working well* depends much on sufficient grinding or fineness of texture. *Keeping their places* and *drying well* belong chiefly to the vehicle or liquid with which the pigments are tempered, and principally the oil with which they are employed.

All substances are positively or negatively colored, whence the abundance of natural and artificial pigments and dyes with which the painter and colorist in every art are supplied, and the infinity of others that may be added to them. As, however, it is *durability* that gives value to the beauty and other qualities of colors or pigments, and those of nature being for the most part adapted to temporary or transient purposes, few only are suited to the more lasting intentions of art, and hence a judicious selection is essential to the practice and purposes of artists.

In *mixing colors* the painter should avoid using a greater number of pigments than necessary to afford the tints required, as such mixtures are usually fouler than the colors used and their drying and other qualities are commonly injured thereby. Nor is it advisable to purchase ready-made compositions and tints that he can produce better by mixture, for this is to submit his own skill and knowledge to the inferior skill and to the gain of others: yet it shall by no means be said that the painter should lose his time in the manufacturing of original pigments, which he can obtain in better quality in the shops.

White Pigments.

The most important group of painters colors are the white pigments. White is the basis of nearly all opaque painting designed for the laying and covering of grounds, whether they be of wood-work, metal, stone, plaster, or other substances. It should be as pure and neutral in color as possible, for the better mixing and compounding with other colors without changing their hues, while it renders them of lighter shades, and of the tints required; it also gives solid

body to all colors. It is the most advancing color; that is, it comes forward and catches the eye before all other colors, and it assists in giving this quality to other colors, with which it may be mixed, by rendering their tints lighter and more vivid. Hence, it appears to throw other colors back which are placed near it, and it powerfully contrasts dark colors, and black most so of all. This term *color* is, however, equivocal when attributed to the *neutrals*, white, black and gray, yet the artist is bound to regard them as colors; and in philosophic strictness they are such latently, compounded and compensated, for a thing cannot but be that of which it is composed, and the neutrals are composed of and comprehend all colors.

White is the nearest among colors in relation to yellow, and is in itself a pleasing and cheerful color, which takes every tint, hue and shade, and harmonizes with all other colors, and is the contrast of black, added to which it gives solidity in mixture, and a small quantity of black added to white preserves it from its tendency to turn yellow.

The most important of the white pigments is

White lead. White lead was known to the ancients. Dioscorides, writing in the fourth century before Christ, states that it was manufactured by exposing lead to the vapors of vinegar, scraping off the crust formed and treating the latter with water, whereby the product, called *psimuthion*, was deposited. Theophrastus, Pliny and Vitruvius also describe its manufacture from lead and vinegar. It was designated by several names, such as cerusa, cerussa, cerosa. It was employed in therapeutics like litharge; for instance, a solution of it in acetic acid yielding, according to Galen, an eye water. Mixed with gypsum and liquid

pitch it was employed as a paint for iron. It was also used, either by itself or colored red with various substances (generally of a vegetable nature), as a face powder or cosmetic. White lead was for a long time considered an acetate of lead, its true composition being established, in 1774, by Bergmann. For many years its manufacture was exclusively carried on by the Venetians and Dutch, but was gradually introduced into other countries, partially modified processes being in some instances employed.

Constitution of white lead and theory of its formation. To obtain, in manufacturing white lead, a preparation of good covering power, it must be endeavored, according to Hochstetter, to form a combination of $2PbCO_3+PbH_2O_2$, or

$$2CO_3Pb.Pb(OH)_2 = \begin{matrix} CO_3 < \\ CO_3 < \end{matrix} \begin{matrix} PbOH \\ Pb \\ Pb.OH, \end{matrix}$$

with 86.32 PbO, 11.36 CO_2 and 2.32 H_2O; hence a basic salt. The neutral salt, $PbCO_3$, with 83.46 PbO and 16.54 CO_2, gives a greater yield by weight, but on account of its crystalline constitution far less favorable results as regards the consumption of oil and covering power, and also renders the product hard. Therefore, the principal methods of manufacturing white lead are based upon the decomposition of tribasic acetate of lead, by the introduction of a sufficient quantity of carbonic acid, that a bibasic carbonate of lead and neutral acetate of lead are formed.

As long as basic acetate of lead in excess is present, *i. e.*, as long as the solution shows an alkaline reaction with turmeric, neutral carbonate of lead cannot exist, because the former constantly converts the latter into

basic salt. If more carbonic acid is introduced, the neutral acetate of lead is also decomposed to carbonate and free acetic acid; the latter being much diluted does not act upon the carbonate, but in a concentrated state decomposes it. The white lead first precipitated from solutions of basic acetate of lead by carbonic acid is richer in hydrate than that precipitated later on, and covers better, so that by a less complete precipitation the quality of the product is enhanced. Generally speaking, the quality of white lead improves within certain limits with the content of lead hydroxide, as well as with that of lead, and decreases with the content of carbonate of lead. It being difficult to maintain an accurate limit, the composition of the ordinary varieties of white lead varies more or less from the normal composition given above by the admixture of varying quantities of neutral carbonate of lead, as has been shown by Hochstetter, while Mulder infers from various analyses that the commercial product is always a constant combination corresponding to one of the following formulæ:

$2PbCO_3+PbH_2O_2$	with	86.27	PbO
$5PbCO_3+2PbH_2O_2$	"	85.86	"
$3PbCO_3+PbH_2O_2$	"	85.45	"
$4PbCO_3+PbH_2O_2$	"	85.00	"

According to Wigner and Harland, white lead is not a basic carbonate, but a mixture of neutral carbonate and lead hydroxide, covering best in the proportion of 3:1 molecules. Lead hydroxide alone with oil does not give a covering paint, and carbonate of lead alone with oil yields only an incompletely covering emulsion.

Manufacture of white lead. White lead is manu-

factured by a variety of methods, the principal ones of which will be briefly described.

Dutch method or stack method. This is the oldest method known, its name being derived from the supposition that it was invented in Holland. It is used in all parts of the world for the manufacture of white lead, and there is but little variation in the details of the process and in the construction of the plant used in different countries.

The plant used in the Dutch or stack process consists of a shed of brick-work about 16 feet long by 13 feet wide and 20 feet high. For convenience sake parts of the structure are in some places built below the level of the ground. A number of earthen pots, resembling in shape crucibles, and generally 8 inches high by 4 inches in diameter, are provided. The pots are glazed inside to half their height, but not glazed outside. In the interior they are provided with a ledge or shelf. Some vinegar (about ½ pint) is brought into each pot, and upon the ledge or shelf is placed a coil of thin sheet lead so that it does not project over the edge of the pot nor come in contact with the vinegar. The stack is built up as follows: A layer of horse-dung which has been previously used is placed upon the floor of the shed, and a layer of fresh horse-dung is spread along the walls. The space left free is then filled with pots prepared as above described. In the centre of the stack and in the corners are placed a few larger pots, which are almost entirely filled with vinegar, but contain no lead. Each layer generally holds 1000 to 1200 pots. Over the coil of lead resting upon the shelf of the pot is placed a layer of three or four lead plates, so that the uppermost forms the lid of the pot. The entire layer is then covered with stout

planks. On the top of the planks is placed another layer of fresh horse-dung, then a layer of pots, then a layer of lead plates, then another layer of boards, and so on until the stack is completely built up. The doorway through which the filling is done is closed as the work progresses by boarding, but a small space is left at the top through which the progress of the operation can be observed, and fresh additions of material made as required, to allow for sinking of the horse-dung, etc. Each stack consists generally of seven, though sometimes also of ten rows of pots. In constructing the stack the separate rows of pots are connected by leaving spaces between the planks so that the air necessary for oxidation can circulate through the stack. A large white lead works, of course, requires a number of sheds with the necessary pots so as to keep the workmen fully occupied.

After four to six weeks the lead is converted into white lead. As a rule, 10 to 15 per cent. of the lead is not corroded; 100 volumes of lead yield 112 of white lead.

Although the health of the workmen does not seem to suffer from the exhalations of the great quantities of horse-dung, the method adopted in England of using spent tan instead is much more agreeable; and although in its operations it is slower than with horse-dung, the product is more regular in composition and not liable to be darkened by the evolution of sulphuretted hydrogen from the decomposing dung. The arrangement of the stacks remains the same. Sometimes a combination of the dung and tan process is employed, the two lowest layers receiving dung and the upper layers tan. The process is somewhat slower than with dung alone, but more white lead is produced. Lead

once subjected to corrosion is more rapidly converted into white lead than fresh lead, especially after exposure for some time to the air.

A great fault of the Dutch process is the irregular manner in which it proceeds, it being impossible to regulate the fermentation. The temperature in the interior of the stack is never uniform, it being in the commencement of the operation as high as 194° and even 212° F., which causes the rapid evaporation of the vinegar, which then either volatilizes or condenses on the exterior cold places without acting upon the lead. However, this can only happen in the commencement of the operation, for when the acetic acid is once fixed on lead oxide, volatilization of it can no longer take place, but even then an uneven temperature is injurious, on account of its being frequently very high in the centre of the stack and comparatively low on the walls, whereby oxidation in that portion of the stack is retarded. The best results are attained when there is a proper degree of circulation of air and a temperature of from 100° to 120° F. is sustained. With too low a temperature the lead is incompletely corroded, and with too high a temperature the white lead readily acquires a yellow color. With an uneven temperature the vinegar vapors pass from the warmer to the colder portions of the stack, in consequence of which the pots located there become filled with vinegar by the condensation of the vapors, and the lead in the pots being submerged in vinegar is not converted into white lead.

When the time necessary for the conversion of the lead into white lead has elapsed, the stack is dismantled. As the boards are removed it is found that the lead which has been corroded still retains its original form. The plates and coils are taken from the

pots and carried in small boxes to the grinding rooms. The method of treating the white lead varies in different works, but the following may be taken as a good example of the usual manner of working: The corroded lead is first passed through a pair of rolls; these break up the masses, the white lead crumbling to powder while the unchanged lead is flattened out into thin sheets. The crushed materials are then passed through a sieve to separate the white lead from unchanged lead. The latter is sent to the melting pot, where it is melted and recast for use in building another stack. The white lead is brought into tanks full of water, where it is thoroughly agitated and the small traces of acetate of lead which the corroded lead contains washed out of it. While still wet the white lead is ground as fine as possible under edge runners or between rollers and then dried, when it is ready for sale. As the grinding must be thorough, the lead is passed through several sets of grinding mills. Grinding white lead is a very unhealthy occupation on account of the fine dust, which flies about the room in which it is done and is breathed by the workmen, who sooner or later suffer from lead poisoning. Much of this danger may be avoided by grinding the lead in a wet condition only, and by drinking water acidulated with sulphuric acid, whereby the lead absorbed into the system is converted into harmless sulphate of lead.

In the white lead works of Walkers, Parker & Co., in the North of England, lead buckles or gratings are used instead of thin plates, and spent tan instead of dung. The lead gratings are not placed in pots, but several of them (5 or 6) are laid, one on top of the other, over shallow earthen dishes containing vinegar. Each of the gratings weighs about 3 lbs. and hence they are

much heavier than the thin coils used in the ordinary Dutch process. However, experience has shown that the gratings are just as readily converted into white lead. When pots are used a six-pointed star of lead is placed upon the shelf over the vinegar and over it a lead buckle or grating rolled together. The vinegar is prepared in the establishment by the distillation of wood, and diluted so that it shows only 1° with the acetometer. The resulting white lead is converted into a fine paste by the addition of water, which prevents dust. The white lead is ground with the constant access of water by passing it successively through three mills, when it is allowed to settle. The clear water is then pumped off, and the white lead dried in shallow earthenware vessels. When dry it is rubbed with 8 to 10 per cent. of oil in troughs provided with stirring shafts, and ground fine between stones.

German or Chamber Method.

A chamber of brickwork is built of any convenient size and with few openings, the usual ones being a door to enter into the chamber for the purpose of filling it, and an opening in the roof for ventilation. Sometimes a window or two for the purpose of observation is added. The chamber has a number of shelves on which are placed sheets or gratings of lead. When all the lead is placed upon the shelves and the openings of the chamber have been carefully closed, currents of aqueous vapor, air, carbonic acid and acetic acid are admitted into the chamber. After a period varying from four to five weeks, the white lead will have been formed. It is collected and treated as in the Dutch process.

Various alterations in the details of this method

have from time to time been made. Burton, for instance, places the lead in coils on the shelves of the chamber and passes the current of steam through perforated pipes, thereby converting the lead into oxide. When a sufficient amount of this has been formed, the current of steam is stopped and a current of acetic acid vapor sent in, which converts the oxide into the basic acetate. When this action is finished the acetic acid current is stopped and carbonic acid gas sent in, which acts on the basic acetate and changes it into basic carbonate or white lead. These currents of steam, acetic acid vapor and carbonic acid gas, are sent in successively until all the lead is converted into white lead. The currents are then stopped and the white lead is collected and finished in the usual way.

The chamber used in the *Hatfield process* is built with a double wall and the bottom is hopper-shaped. The lead is in the form of gratings and placed in trays on shelves in the chamber. Water and acetic acid in the form of spray are sent into the chamber, the temperature of the latter being at the same time maintained at a suitable point by means of steam pipes. The action of the water and acid is to convert the lead into basic acetate of lead. When this has been properly formed the water and acetic acid spray is stopped, and a current of carbonic acid gas sent in to form white lead.

The principal faults of the German or chamber process are, according to Weise, as follows:

1. With an excess of carbonic acid gas hard white leads with slight covering power are formed, in consequence of too large a content of carbonate of lead and want of lead hydroxide, as shown by the following analyses:

	a	*b*	*c*	*d*	*e*
Lead monoxide.	86.80	86.24	86.03	84.69	83.47
Carbonic acid. .	11.16	11.68	12.28	14.10	16.15
Water.	2.00	1.81	1.68	0.93	0.25

a. Lead of the best quality; good both in color and body. *b.* Second quality, not so good as *a*, but still very serviceable as a pigment. *c.* Third quality, just usable as a pigment. *d.* Not usable except for very ordinary purposes. *e.* Not usable at all; it contains too much carbonate, and is sent to the smelting furnace.

2. The formation of colorations; *a gray coloration* in consequence of the presence of too much carbonate of lead or an admixture of very finely divided metallic lead; *a yellowish or reddish* coloration due to a content of lead oxide not fixed to carbonic acid or water, which is formed in consequence of a want of acetic acid or aqueous vapor in the chamber. An intensely colored product of this kind contained 93.70 per cent. lead monoxide, 5.31 carbonic acid, and 0.90 water; hence 55.64 per cent. lead monoxide free from water.

French method or wet precipitation process. In this process the lead is used in the form of a solution and the precipitation is effected by means of a current of carbonic acid gas.

Thénard's process. Thénard, in 1801, proposed the utilization of the behavior of a solution of basic acetate of lead towards carbonic acid for the preparation of white lead. The process was later on worked on a large scale by Roard at Clichy, in consequence of which it became known as the Clichy or French process. The various operations consist in bringing litharge into dilute vinegar until the fluid shows 17° or 18° B. It then contains for every 2 molecules acetic acid

3 molecules lead oxide. This basic acetate of lead is decomposed by carbonic acid gas obtained by the combustion of charcoal, coke, or from lime kilns or other sources rich in carbonic acid, whereby carbonate of lead is separated, while neutral acetate of lead remains in solution. The neutral solution is separated from the precipitate and again used for the solution of lead oxide. Hence the same quantity of vinegar is constantly reëmployed, there being only the very slight loss of the acetic acid which remains adhering to the washed precipitate.

The product obtained by this process is fairly good, but liable to vary in composition from time to time according to the strength of the solution of basic acetate of lead and to the basicity or proportion of lead oxide the lead acetate has dissolved.

Ozouf's method as employed at St. Denis is an improvement of Thénard's process in so far that pure carbonic acid gas is used for pecipitation, the resulting product being similar to that obtained by the Dutch process. The preparation of pure carbonic acid gas is effected in a special apparatus, and is based upon the gas mixed with other gases being absorbed by a solution of sodium carbonate and again liberated by heating the latter.

Preparation of white lead from litharge. This process, originally proposed by Benson and Gossage, consists in stirring dry litharge with a one per cent. solution of acetate of lead to a moist powder, which is treated with carbonic acid. The litharge is kept in constant motion upon a metal-plate by a fluted roll passing over it, so that the basic acetate of lead formed constantly presents fresh surfaces to the carbonic acid. The carbonic acid is obtained by the combustion of

coke. When all the lead oxide is converted into white lead, the latter is ground, elutriated, dried and brought into commerce either itself or ground with oil.

The use of ordinary litharge for the preparation of white lead has the disadvantage that it always contains more or less iron and copper, the former imparting a yellowish color to the white lead, and the latter causing the coating of paint to turn yellow on exposure to the air. For this reason only litharge freed from copper by treatment with ammonia should be used. Woellner recommends the effecting of the treatment of the litharge in revolving cylinders and adding at the same time an equal volume of granulated lead to the litharge.

Besides the processes above described others have from time to time been proposed or patented, a few of which may be mentioned.

Pattinson's white lead is made by treating chloride of lead with lime, when it forms the basic chloride, a white insoluble body, having fair covering power, but wanting in uniformity of composition.

Martin prepares carbonate of lead so that it shall contain a slight excess of carbonic acid. Hydroxide of lead is prepared by thoroughly agitating granulated lead with water under access of air. The hydroxide is mixed with carbonate of lead in the proportion of 8 lbs. of the former to 1 ton of the latter, the mixture being made by grinding with water into a paste.

Millner stirs together finely ground lead oxide with the chlorides of potassium, sodium and ammonium, whereby lead oxychloride is formed and converts the latter into a basic carbonate of great covering power by the introduction of carbonic acid.

Sublimed white lead. This product is the invention of G. T. Lewis, and was first patented in 1879. About 1870 a vein of ore containing both lead and zinc, being a mixture of galena and blende, was discovered in the United States. This was smelted for lead which, on account of its being different in properties from ordinary lead, was distinguished as "Bartlett lead." The presence of zinc in lead ores being very detrimental, the process of making white lead was devised to utilize this lead-zinc ore.

The ore is ground, roasted, heated with coal in a similar manner to zinc-white from ores, and the volatilized metal is oxidized. A mixture is obtained which consists essentially of zinc oxide and lead sulphate.

Sublimed white lead is a powder of a fine white color, though sometimes it has a gray tint; the white has a rather bluish hue. It is heavy, a cubic foot of it weighing about 200 lbs. It is quite insoluble in water, is partially soluble in dilute nitric acid, which dissolves out the zinc oxide, lead oxide, or lead carbonate the pigment may contain. As a rule it is completely soluble in boiling hydrochloric acid, although some samples contain a little barytes which remains behind as an insoluble residue on treatment with the acid.

Freeman's non-poisonous white lead. The base of this white lead is the sulphate made from metallic lead by precipitation. It also contains zinc oxide, barytes, and, in the earlier makes, a little magnesia, all the ingredients being mixed together by a process of grinding under edge runners. The non-poisonous white lead is a very good pigment, is more permanent under exposure to atmospheric influences than ordinary white lead, and is equal to the latter in body or

covering power and in freedom of working. It is rather heavier than white lead, weighing about 180 to 190 lbs. to the cubic foot.

Properties of white lead. The pure product dissolves completely in dilute nitric acid, as well as in potash and in soda lye. When exposed to sulphuretted hydrogen or moistened with ammonium hydrosulphide it turns brown or black, whereby it is distinguished from zinc-white. When heated with the access of air it yields its carbonic acid, and at 572° F. passes into lead oxide and finally into minium. When digested under pressure with carbonated water for some time, the water may contain 0.22 drachm of lead per quart. The difference in covering power is due to the form, size, density and composition of the smallest particles. The white lead obtained by the French or precipitation process is looser, of a coarser grain, and possesses less covering power than the product obtained by the Dutch or German process, which is denser, of a finer grain, and never crystalline, and, though of a greater specific gravity, requires less oil.

When exposed to light and air, white lead is fairly permanent and will resist exposure to normal conditions for a great length of time; on the other hand, when exposed to the fumes of sulphuretted hydrogen and other sulphurous gases, white lead turns brown or black through the formation of the black sulphide of lead. The production of this body is more likely to occur in large towns, where great quantities of gas are used for lighting and other purposes, which usually contains some sulphuretted hydrogen or other sulphur compounds.

White lead can be mixed with all pigments except those which, like cadmium yellow, ultramarine or

King's yellow, contain sulphur; such pigments sooner or later causing the formation of the black sulphide, and thus bringing about the discoloration of the pigment or paint.

In commerce white lead is found in two forms, viz. as a heavy white powder, having a specific gravity of about 6.47 and weighing about 180 lbs. to the cubic foot, or as a paste containing about 8 per cent. of linseed oil. To make the latter, the dry white lead is first mixed in a mixing mill with about 8 to 9 per cent. of its weight of raw linseed oil; it is then run through a grinding mill several times to ensure a thorough mixture of the oil and white lead. This form is much liked by painters, it being more readily miscible with oil and turpentine to make it into paint.

In order to obtain a cheaper product, white lead is frequently mixed with barytes (heavy spar) which is distinguished by its white color and great specific gravity. The mixture is often effected in fixed proportions and for certain varieties of white lead, which are known by special names or numbers, remains unchanged. Thus *Venetian white* consists of equal parts white lead and barytes, *Hamburg white* of 2 parts barytes and 1 part white lead; *Dutch white* with up to 75 per cent. barytes. White lead is also distinguished as No. 1, genuine, No. 2 with $\frac{1}{5}$ barytes, No. 3 with $\frac{2}{5}$, No. 4 with $\frac{3}{5}$ and No. 5 with $\frac{4}{5}$. The so-called *Kremnitz white* is a pure white lead. It is produced by placing trays containing a paste made of litharge and either acetic acid or lead acetate upon shelves in a chamber built of brick or wood. When the chamber is filled carbonic acid gas is sent into it and is absorbed by the lead oxide present in the paste, the absorption of the gas being facilitated by raking over the paste from

time to time. The mass originally has a yellowish gray color, but as the operation progresses it gradually changes into white. When all traces of yellow have disappeared, the operation is stopped, and the white lead is first washed with water, then ground and dried. It is brought into commerce in pieces or small cubes, which in consequence of a content of acetate of lead are very hard, difficult to comminute and they break with a conchoidal fracture.

Testing white lead. The best white lead contains 1 to 3 per cent. of water, traces of chloride, sulphate and sulphide of lead, metallic lead, and sometimes acetate of lead is intentionally added to make the product harder. White lead may be tested by painting-tests, or it may be examined chemically. For the former Chandler recommends to intimately mix 100 parts of white lead rubbed with oil with 1 part of best lamp-black and a little boiled linseed oil, and to apply the mixture with a steel spatula to a glass plate, whereby the purity of the white lead may be recognized from the color of the coat.

Pure white lead of 5.5 to 6.4 specific gravity readily fuses upon coal and rapidly yields, without odor of sulphuric acid (sulphate of lead) a metallic button and yellow film. The presence of earthy combinations renders fusing more difficult, and, as a rule, only small metallic grains result with soda.

The purity of white lead is ascertained by dissolving a sample of it in pure dilute nitric acid (1 acid, 2 water). On adding dilute sulphuric acid to the solution, after diluting it with water and filtering off the precipitate of lead sulphate thus obtained, no further precipitate should be formed on successively adding ammonia, ammonium sulphide and ammonium oxalate to the filtrate.

A white precipitate with ammonium sulphide would indicate the presence of zinc white, which is rarely found with white lead; a white precipitate with ammonium oxalate would indicate the presence of whiting.

The insoluble residue, if any, will consist most probably of barytes, as other adulterants are rarely used. However any lead sulphate, china-clay, gypsum or strontium sulphate which may be used would also be left as an insoluble residue on treating white lead with dilute nitric acid. To distinguish these bodies, boil the residue in hydrochloric acid and allow the solution to cool; if crystals of lead chloride separate out and the solution gives a white precipitate with barium chloride, then lead sulphate is present.

The hydrochloric acid solution should be diluted with water and sulphuretted hydrogen passed through it. The black precipitate of lead sulphide which may be obtained can be disregarded. Filter it off and boil the filtrate for some time to concentrate it and to drive off the sulphuretted hydrogen it contains. Then ammonia is added, when a white precipitate of alumina may be obtained which indicates the presence of china clay. Filter this off, and add to the filtrate ammonium carbonate, which will precipitate any calcium that may have been added in the form of gypsum or whiting.

A little of the insoluble residue from the hydrochloric acid solution should be held on a piece of platinum wire in the lower part of a Bunsen flame, when, if it contains barytes, the flame will be colored green; if strontium sulphate is present, a crimson flame will be obtained. This test is not always easy to carry out, but with a little care the colored flames may be ob-

tained and they are an excellent proof of the presence of the pigments named.

White lead may also be tested with the *blow-pipe*, the operation being conducted as follows: Take a piece of charcoal about 1½ inches broad and ½ inch thick. Hold it flat and scoop out of one end of it a cup-like cavity, about as large in diameter as a dime. Place in this depression a piece of the white lead about the size of a pea. Now, take a blow-pipe, and direct a flame upon it from a gas jet. In order to produce successful results, it should be borne in mind that an intense heat is required, which can only be obtained by directing the flame *steadily* on the same spot. To insure the flame being directed steadily, it is well to support the blow-pipe on something, such as part of the gas bracket, and also to support the charcoal, holding it in the left hand, and inclining it somewhat to receive the flame. Those who are not used to handling blow-pipes have considerable difficulty in keeping up a continuous blow. The only way in which success can be obtained is to inflate the cheeks, and to breathe through the nostrils; do not obtain the supply of air from the lungs, but from the cheeks. After a little practice it will be found one can blow steadily for a great length of time. The tip of the blow pipe must always be placed in the blue part of the flame, and the white lead to be tested must be held in the point of the blue "blow-pipe flame." Care must be taken not to hold the white lead further away from the blow-pipe than this point, or the operation will be very greatly prolonged. If the white lead to be tested is pure and a sufficient heat is obtained, it will in a few minutes be reduced to a small, pea-like leaden globule, having an appearance not unlike quicksilver. If,

however, it is adulterated, it will leave, as a deposit, a cinder-like substance varying in color according to the adulteration. As little as 5 per cent. of adulteration can be detected in this manner.

Zinc white. This pigment, also called *Chinese white*, consists entirely of the oxide of the metal zinc and has the composition: Zinc (Zn) 80.25 per cent. oxygen (O) 19.75 per cent. It is prepared from metallic zinc by heating in the air, or directly from the ores. The zinc is heated in fire-clay retorts resembling those used in the manufacture of illuminating gas. They are provided with an aperture for the introduction of the charge and the escape of the zinc vapors. The vaporizing plant consists of a furnace of the reverberatory type, in which are placed a number of retorts. The furnaces are made double, back to back, so as to accommodate two sets of retorts. When the retorts have been raised to a white heat, the ingots of zinc are thrown in. The metal is converted into vapors which escape through the aperture in the retorts, and directly on escaping from the latter meet a current of air heated to 572° F. by which the zinc is burned and converted into zinc oxide. The loose zinc oxide thus formed is carried by the current of air into chambers in which it gradually deposits. The product thus obtained is of a white color, and without previous grinding or washing can immediately be combined with oil.

In the preparation of zinc white directly from the ores, the roasted ore is brought to a red heat upon the grate of a furnace previously charged with fuel (coke or anthracite), and a current of air is then conveyed under the grate. When the zinc commences to evaporate, the escaping vapors are converted into zinc white by being conducted to the precipitating chambers

through a system of pipes, in which they are strongly heated with the access of air. Zinc oxide may also be obtained by treating zinc with superheated aqueous vapors (with the development of hydrogen.) Zinc white is more costly than white lead. It has the advantage over the latter that it remains unchanged by exposure to air and light, and chiefly that sulphur or sulphur gases have no visible action on it, the sulphide formed being white like the oxide. It is a rather bulky, fine white powder of a slightly bluish hue, and has a specific gravity of 5.6. It is quite insoluble in water, oii, alcohol and turpentine. It dissolves in dilute sulphuric acid, hydrochloric acid, acetic acid and many other acids, without effervescence, giving colorless solutions. It is also soluble in ammonia and alkaline solutions. It can be mixed with all other pigments without undergoing any change or changing the other pigment.

The purity of zinc white in oil may be tested by burning out the oil by means of a blast lamp, on an iron spoon or ladle. Take of the zinc white a piece about the size of a pea, place it in the centre of the spoon and direct the blast on it until it is burned white and perfectly dry. Crush the white cinder which is left to a fine powder and drop this into a glass of diluted sulphuric acid (1 acid to 10 water). If the powder be fine and very little dropped in at a time, it will, if pure, dissolve completely before reaching the bottom and without effervescence. If there be any effervescence it indicates the presence of whiting, which will precipitate as sulphate of lime, which is, however, sparingly soluble; barytes is insoluble, and a considerable adulteration of terra alba is not readily soluble; clay is insoluble.

Zinc sulphide has also been prepared as a pigment, *Orr's white enamel or Charlton white* and *Griffith's patent zinc white* being examples of it. The liability of sulphide of zinc white to evolve sulphuretted hydrogen renders its use as a pigment dangerous, for there are several other colors upon which it would exert a deleterious action. However, Griffith's patent zinc white is very largely used as a pigment. Its color is good and in body it is nearly, if not quite, equal to that of white lead. It is claimed that it does not become discolored by exposure to sulphuretted hydrogen, or to any other sulphur compounds. It resists exposure to all atmospheric agencies, and is very permanent. It mixes well with oil, working very freely under the brush. It mixes with all pigments, excepting those containing lead or copper, without being changed by them or changing them in any way.

Barytes or heavy spar is one of the most important white pigments. In composition it is the sulphate of the metal barium, and is obtained from both natural and artificial sources. In nature heavy spar occurs in the form of large crystalline masses, generally opaque, but sometimes transparent pieces are found. Its specific gravity is 4.3 to 4.7 ; its hardness 3 to 3.5.

The preparation of heavy spar as a pigment is effected by grinding it to a powder, it being successively passed through several mills of special construction. From these mills the ground heavy spar is passed to settling tanks, which are usually constructed of stone. The heavy spar settles in a few hours, when the supernatant water is drawn off. The powder is then subjected to a bleaching process to free it from any yellow tint which, in almost all cases, is due to oxide of iron, from which heavy spar is rarely free. The wet pow-

der from the settling tanks is run into stone cisterns and heated up to nearly the boiling point by means of a steam-pipe fitted to the cistern. A quantity of hydrochloric acid, about 1 cwt. to 1 ton of crude heavy spar, is then added. The acid extracts the oxide of iron, leaving the heavy spar quite white. After treatment with acid the heavy spar is allowed to settle, the acid liquor is next poured off, and the heavy spar washed with water to remove all traces of acid. In some works the washed heavy spar is next subjected to a levigating process to obtain as fine a quality as possible, the coarser qualities being sent back to the mills to be reground. The heavy spar is then dried, which is generally effected in two stages. From the settling tanks it is thrown on to the tops of drying flues, where it is allowed to remain until it becomes sufficiently dry to adhere together and is then cut up into large bricks which are transferred to the drying stoves, where they are allowed to remain until properly dry, several days being required for the process. When dry the bricks are removed from the stoves and ground up in the mills to a fine powder.

Floated barytes is a fine quality, prepared by a process of levigation. In other respects, it does not differ from ordinary barytes.

Permanent white or *blanc fix* is artificially prepared barium carbonate. It is obtained by preparing a cold solution of barium chloride of specific gravity 1.19 and gradually adding to it, in the cold, dilute sulphuric acid of 1.245 specific gravity until no further precipitate is formed. The barium sulphate is washed with cold water until the wash waters are entirely free from acid.

Ordinary barytes or heavy spar is a fine and rather

heavy white powder having a specific gravity of 4.5 to 4.75. It is quite insoluble in all acids and alkalies, a property which distinguishes it from other white pigments. It is absolutely unalterable by an impure atmosphere and as a pigment it is the most permanent white known. It mixes quite well with oil, of which it takes about 7 per cent. to grind into a stiff paste. As an oil paint it is satisfactory in use, but for water colors it is not so good, seeming to lose some of its body on mixing with water. It is largely used for mixing with other pigments, especially with white lead, many commercial samples of the latter containing, as previously mentioned, 20 to 25 per cent. of barytes.

The artificial barytes or permanent white may be distinguished from the natural by its much finer state of division, by its greater body and the purity of its whiteness.

Barytes being cheap is not adulterated, but its almost absolute insolubility in hydrochloric or nitric acid enables it to be at once distinguished from white lead or zinc white.

Gypsum is a variety of calcium sulphate, and has the formula $CaSO_4$. It is found in considerable abundance in many parts of the world. It is often associated with rock salt. When regularly crystallized it is termed selenite. The most useful form is that in large opaque and semi-opaque masses, which yields *plaster of Paris*, for when heated to between 300° and 400° F., it loses its water, and if the mass be then powdered and again mixed with water, the powder recombines with it to form a mass of hydrated sulphate of lime, the hardness of which nearly equals that of the original gypsum.

For use as a pigment gypsum is ground up in the

same way as barytes, when it is obtained in the form of a soft white powder of a very good color known as *terra alba*, *mineral white*, *satin white*, etc.

Gypsum mixes well with either water or oil, and, being neutral in its properties, it can be mixed with all other pigments without affecting them or being affected by them. It is used very largely by paper stainers and makers of wall paper, who prefer it to barytes on account of its having more body when used for that class of work. It is used in finishing of cotton goods, in paper making, and for a variety of other purposes where a cheap white pigment is required.

Whiting. This body is sold under a variety of names, such as *Spanish white*, *Paris white*, *English white*. Whiting is the carbonate of calcium $CaCO_3$, purified by washing. It is prepared by grinding chalk under water to a very fine powder by passing it through several mills. The powder is run into tanks in which the coarser and heavier particles settle, while the finer chalk passes on to other tanks in which it settles. When the settling tanks are full, the chalk or whiting is dug out and dried. When partially dry it is cut into masses of a cubical shape and dried in the same manner as described under barytes. When dry it is ground.

Paris white is a finer quality of whiting, but the grinding is more thoroughly done. *Spanish white* is a name given to Paris white sold in a cylindrical form prepared by moulding the wet material into that form, and allowing it to dry in the open air.

Whiting is a dull white powder of an amorphous character, and soft to the feel. Its specific gravity is about 2.5 to 2.8. It is quite insoluble in pure water, but is soluble in water containing carbonic acid gas in

solution. As a pigment it is mostly used as a body color in distemper work, coloring walls, ceilings, etc., using water as a vehicle. It cannot be used as an oil color, for when mixed with oil, it loses its white color and turns a dirty gray. Mixed with about 18 per cent. of linseed oil, it forms the useful article known as putty.

Kaolin or China clay is essentially a hydrated silicate of alumina. It is a natural product and only requires levigating and drying to prepare it for use as a pigment. It occurs in large deposits along with other constituents of undecomposed granite, the china clay usually forming from 15 to 20 per cent. of the whole deposit.

Kaolin is a fine, white amorphous powder, having slight adhesive properties and adhering to the fingers when moist. Its specific gravity is about 2.2. The best qualities have a very soft unctuous feel and a pure white tint, while the common qualities are rather rougher, and of a more or less yellowish hue.

As a pigment kaolin is quite permanent, resisting exposure to the atmosphere and to light for any length of time. It is, however, not much used as a pigment. In oil it loses its body and becomes more or less transparent. It can be used in water colors and in distemper work with good results, and is employed in paper-making and paper-staining.

For distinguishing white pigments, Bolley gives the following characteristics:—

Names and composition of the white pigments.	Behavior towards hydrochloric acid.	Behavior towards caustic potash lye.	Behavior in incinerating.	Special characteristics.
Chalk (whiting, Spanish white, Paris white, English white.)	Soluble in the cold with strong effervescence	Unchanged.	Browns turmeric paper.	
White lead (Kremnitz white, etc.)	Soluble with effervescence and separation of small crystals in concentrated acid.	Soluble without residue; poor qualities leave behind up to 75 per cent. residue.	In the heat yellow; yields upon coal grains of metallic lead.	Is blackened by sulphuretted hydrogen. Poisonous.
Zinc white, oxide of zinc.	Soluble without effervescence.	Soluble without residue.	Becomes yellow in the heat.	When heated with cobalt solution a green mass is formed.
Barytes (heavy spar, barium sulphate.)	Unchanged.	Unchanged.	When heated with coal and moistened with hydrochloric acid, it smells of sulphuretted hydrogen.	Very heavy; non-poisonous.
Gypsum.	Unchanged.	Unchanged.	When heated in a flask it yields water; in all other respects like barytes.	Sparingly soluble in water; the solution becomes turbid by adding barium nitrate and ammonium oxalate. Non-poisonous.
China clay (Kaolin) and talc.	Unchanged.	Unchanged.	When heated in a flask it yields water; in all other respects like barytes.	When heated with cobalt solution, kaolin turns blue. Talc has an unctuous feel and is foliated. Non-poisonous.

Red Pigments.

Red pigments are derived from both inorganic and organic sources, and form a numerous and important class of painters' colors.

Vermilion. The mineral cinnabar or mercuric sulphide occurs in many parts of Europe, especially in Spain. An abundance of it is found in China, and it is extensively worked in New Almaden, California. Its color in the mass varies from cochineal red and red-brown to lead-gray ; its powder is usually scarlet or red. Its hardness lies between that of gypsum and calcspar. It seldom contains even 1 part in 100 of impurities, but consists in 100 parts of very nearly 14 parts by weight of sulphur combined with 86 of mercury, or 1 atom of each element. The specific gravity of native vermilion is very nearly 9.

The pigment vermilion may be made by simply grinding selected pieces of native cinnabar, but the product, as a rule, is not of sufficient brightness, and the pigment is, therefore, generally made artificially.

All the methods of preparing vermilion artificially may be grouped under two divisions, viz., the *dry way* and the *wet way*. In the dry method, metallic mercury 42 parts and sulphur 8 parts are intimately mixed and agitated together in revolving drums until they are combined. The brownish-black powder thus obtained is then submitted to sublimation in vertical iron cylinders surmounted by heads which are connected with receivers. On sufficient heating, the mercuric sulphide sublimes as cinnabar or vermilion, the best portion condensing in the retort-heads. The rest of the sublimed product, which has travelled further, contains free sulphur, and is of inferior color. The selected portions are next ground, moistened with water,

warmed with a little caustic potash solution or nitric acid, and then thoroughly washed with boiling water.

In another dry process the mercury is gradually added to the proper proportion of melted sulphur in an iron basin. When the combination, which is accompanied by a violent evolution of light and heat, is complete, the fused blackish mass is poured out, broken into fragments, heated until the excess of sulphur is driven off, and then sublimed in the way already described. Some makers add to the crude sulphide, previous to sublimation, 1 per cent. of antimony sulphide with the object of improving the color. The product is finally ground, digested with liver of sulphur, and then washed with hydrochloric acid.

There are numerous processes of preparing vermilion by the wet way. One of the best of these consists in grinding, in the presence of water, 100 parts of mercury with 38 parts of flowers of sulphur until these elements have united. The black product is then triturated at 113° F. for many hours, with a solution of 25 parts of caustic potash in 150 parts of water. When the product has attained its maximum of redness and beauty, it is thrown into water and thoroughly washed by decantation.

In a second process mercury, sulphur and pentasulphide of potassium are boiled together for three or four hours and then the mixture is kept at a temperature of 122° F. for several days.

Vermilion is a very bright scarlet powder. It is the heaviest pigment known, its specific gravity being 8.2, which causes it to settle readily out of paints, etc., in which it is used and renders its application somewhat troublesome. It is very opaque and consequently has great covering power or body. It is quite insoluble in

water, alkalies, and any single acid, but a mixture of nitric and hydrochloric acids dissolves it with the formation of a colorless solution of mercuric chloride.

Vermilion prepared from the mineral or native cinnabar is probably less liable to change than the artificial products, whether obtained by the dry or wet way, but the "wet way" vermilions are certainly the most alterable. It may also be remarked that the more finely a vermilion is ground the less stable it is —at least as a water color.

Commercial vermilion was formely adulterated with minium, ferric oxide and Derby red (basic chromate of lead), while at present heavy spar or gypsum is frequently found as an admixture. On heating, these substances remain behind. Minium, the most common adulterant of vermilion, may be established by the fact that vermilion adulterated with it turns brown on pouring nitric acid over it, and on treating it with hydrochloric acid evolves chlorine.

Red lead or minium, Pb_3O_4 is more orange red and less fiery than vermilion, but is much cheaper, and is highly esteemed for its covering power. It is obtained by heating lead oxide in what is called a "drossing oven," a kind of reverberatory furnace, with the access of air. Only a slight heat should be employed, as otherwise the lead oxide would fuse and be converted into litharge, which cannot be oxidized to red lead. During heating the mass is constantly stirred.

Red lead is a heavy, bright red powder of an orange hue; its specific gravity being 8.53. Heat turns it to a dark brownish red, but the color is restored on cooling. Nitric acid and glacial acetic acid first dissolve out the monoxide, leaving the dark puce oxide; on further boiling this gradually dissolves, and colorless

solutions of the nitrate or acetate are formed. Hydrochloric acid when heated with red lead decomposes it with the evolution of chlorine and the formation of the chloride, which settles as the solution cools in the form of transparent crystals, a very characteristic reaction of lead. Sulphuric acid boiled with red lead forms the sulphate, with the evolution of oxygen.

Red lead is a combination of the two oxides of lead, the monoxide and the puce or dioxide; the percentage composition being, lead monoxide, PbO, 64.5, lead dioxide, PbO_2, 35.5.

Red lead is quite an important pigment now, and promises in the future to be more so. Architects, engineers and all others interested in structural iron works have almost unanimously decided that pure red lead is the proper first coat for iron. Red lead will saponify oil very quickly and therefore it should be freshly prepared for use. Many mix the dry red lead with oil as they use it, but this is not satisfactory, nor will the small hand-mill of the shop grind it sufficiently, though it is better to run it through such a mill than not to grind it at all. When a painter has a large job to do with red lead he should have it ground for him by the manufacturer in such quantity as he would use up in two or three days. It should be well ground in a thin paste, say about 20 lbs. of oil to every 100 lbs. of red lead.

Orange lead. This pigment is identical in composition with red lead. It is obtained by roasting pure white lead with an oxidizing flame at a low red heat in a reverberatory furnace for 24 to 48 hours until the mass has acquired the desired red tint. It is lighter in weight and has a less fiery color than red lead.

Iron reds. These are an interesting group, and iron

probably gives as much paint material as any other element, even including lead. It must be remembered that all the ochres, umbers, siennas, metallic browns, etc., get their coloring from iron, and the aggregate of these will equal the lead colors.

Ferric oxide, FeO_3, the red oxide of iron, is the basis of a very large number of red pigments which are sold under the names of *rouge*, *light red*, *Indian red*, *red oxide*, *Venetian red*, *purple oxide*, *scarlet red*, *etc.*, which are all red pigments of varying shades of color. In the hydrated form, ferric oxide, as above mentioned, also forms the coloring principle of the ochres, siennas and umbers. The red oxides are valued very highly as pigments on account of their generally fine color and their permanence.

The pigments are prepared both from natural and artificial sources. The preparation from the natural oxide of iron is comparatively simple. The mineral is first ground so as to reduce the large masses to small pieces; then these are several times passed through a roller mill until they are fine enough, or they may be put through a horizontal stone mill fitted with a hopper for levigating, and the ground pigment is levigated to free it as much as possible from grit, after which it is dried.

As a rule the natural oxide reds are quite pure products. They are generally dark, and sold as Indian red and red oxide. *Indian red*, according to its name, was first brought from Bengal and is a very rich hematite ore. It is an anomalous red, of a purple-russet hue, and of a good body. The pigment varies considerably in color, that which is the most rosy being esteemed the best and affording the purest tints.

Artificial iron reds are obtained as by-products in

the manufacture of fuming sulphuric acid, in which the residues from glowing iron sulphates are subjected to a fresh heating operation with the addition of common salt. In England and some parts of Germany iron red is produced by calcining iron sulphates obtained from pyrites waste in a muffle furnace. According to the temperature employed the various shades from orange-red to brown and violet are obtained. The names for iron reds, as now used, are usually indicative of the shade of red: thus rouge colcothar, scarlet red and Turkey red are bright reds, Venetian red is pale red; light red is rather darker, but is usually paler than those above enumerated; Indian red and red oxide are dark reds, while light and dark purple oxides are of a dull violet hue.

Venetian red originally consisted of a native ferric oxide or red hematite. But of recent years the name appears to have been transferred to a particular quality of artificial ferric oxide made by calcining green vitriol. When this salt is heated in a crucible the upper portion of the product, which has been less strongly heated than the lower, is of a brighter red than the remainder, and after washing and grinding is sold as Venetian red.

Red oxide pigments form red powders of various shades from a pale red to a dark violet, the specific gravity of which varies from 2.6 to 3.1. They are quite insoluble in water, and more or less insoluble in acids. If the oxide has been made at a low temperature, as for instance rouge, it will dissolve in strong hydrochloric acid; if it has been made at a higher temperature, Indian red for example, it is not readily soluble in hydrochloric acid, and requires a mixture of that acid and nitric acid to effect its solution, while

the purple oxides which have been prepared by calcining at a very high temperature are very insoluble bodies, and require to be treated with a mixture of sulphuric, hydrochloric, and nitric acids before they will dissolve.

As a pigment, red oxides are perfectly permanent under all conditions. They mix perfectly with all pigments without either affecting them in any way or being affected by them. They do not mix as well with oil as red lead, take about 10 per cent. of oil to grind into the usual stiff paste, and do not act as driers.

Antimony vermilion or antimony orange is a pigment closely resembling vermilion. It is obtained by allowing a solution of sodium thiosulphate (hyposulphite of soda) to act upon a solution of antimony chloride. On heating to boiling a precipitate is formed which is washed and dried. It is a delicate scarlet powder, unalterable by air or light, or by deleterious atmospheric agents. It may be used both as an oil paint and a water color.

Brilliant scarlet is the name given to the iodide of mercury, $Hg\ I_2$, prepared by carefully precipitating a solution of mercuric chloride with a solution of potassium iodide. It has a brilliant scarlet color, but is very fugitive. It is rarely used as a pigment.

Tuscan red is essentially a mixture of Indian red with some sort of lake color. The cheapest article is made from a reduced Indian red and rose pink. The richness of such article is very fleeting, particularly if the rose pink be simply whiting colored with a coal tar dye. It is apparent that the real value of a Tuscan red lies in the permanency of the lake coloring material employed to give it richness.

If a large percentage of a pure and fine Indian red be used, a very strong lake must be selected to secure brilliancy. The first quality of Tuscan red to be noticed is its brilliancy; next is opacity or body; its strength in tinting is not a very reliable guide to its value, for a dull and low-priced Tuscan red can very readily be of much greater staining power than a much more costly one. The quality of the tint, however, is a very good indication of the quality of the material employed in making the red.

Fineness of grinding must be insisted on, because a Tuscan red, rich when coarse, may lose its richness when ground fine; that is when the strength of the Indian red element is fully developed.

The relative permanency may be quickly determined by painting out samples, exposing them for several weeks in the sum, and comparing them with duplicates kept in a shady place.

Derby red is the basic chromate of lead. It is also called *chrome vermilion* and *Austrian vermilion.* It is formed from neutral lead chromate by withrawing from the latter half its chromic acid by potassium, either by fusing with saltpetre or by potash lye. On a small scale Derby red is prepared by bringing saltpetre to the fusing point at a very moderate red heat and gradually introducing neutral chrome yellow in small portions. The mass in the crucible is extracted with water; the Derby red which is separated is thoroughly washed and dried. The pigment thus obtained is of a beautiful vermilion color, and consists of lustrous particles of crystals.

In the wet way Derby red is prepared by precipitating acetate of lead with a solution of potassium chromate to which a small quantity of caustic potash has previously been added.

All chrome reds from the darkest vermilion to the dullest minium color are distinguished one from another only by the size of the crystals of which the powder consists. If, for instance, chrome yellow of the most varying shades be reduced to a powder of uniform fineness, a product of equal darkness is obtained and the brilliant color rivaling vermilion disappears. If therefore a chrome red of great depth of color is to be produced, the formation of crystals must be in every way assisted and every disturbance by stirring etc., be carefully avoided.

Especially beautiful basic lead chromate comes into commerce from Cologne under the names of chrome garnet and chrome carmine.

CHARACTERISTICS OF RED PIGMENTS.

Names and composition of the red pigments.	Behavior: Towards hydrochloric acid.	Behavior: Towards caustic soda lye.	Behavior: Before the blowpipe.	Special characteristics.
Vermilion (cinnabar, mercuric sulphide).	Unchanged.	Yellowish on boiling.	Volatile, with an odor of sulphuric acid.	Turns brown to black when moistened with silver nitrate and ammonia solution.
Red lead (minium).	Turns white under the evolution of chlorine.	Slightly changed.	Yields upon coal metallic lead grains and a yellow film.	Turns brown with nitric acid. Poisonous.
Derby red (basic chromate of lead).	Green solution with a white sediment.	Soluble with a yellow color; frequently a white residue.	Red-brown; fusible; with soda upon coal metallic lead grains.	Poisonous.
Iron reds (ferric oxide, red oxide, Indian red, Venetian red).	Slowly solnble with a yellow color.	Unchanged.	Red-brown to black-brown.	Non-poisonous.
Carmine with a little alumina.	Dissolves yellowish.	Violet solution.	Burns leaving behind a little white ash.	Dissolves completely in ammonia.
Red lakes, decoction compounded with alum and precipitated with soda, or vice versa (Florentine lake, crimson lake, Vienna lake, Venice lake). a. From cochineal. b. From the coloring matter of lac. c. From madder, d. From Brazil wood.	Yellow, turbid solution.	Violet-red solution.	Leave behind quite a considerable quantity of ash.	Lac-dye in mass, quite hard and attacked with greater difficulty by chloride of lime solution than the others.

Yellow and Orange Pigments.

Yellow and orange are colors abundant throughout nature, and there is quite a large list of pigments of these colors derived from the vegtable, animal and mineral kingdoms. The most important, however, are the chromes and ochres, the others being only used in small quantities.

The *chromes* are particularly susceptible to adulteration, it being frequently difficult to find one of these colors over 50 per cent. pure. They vary in color from a pale yellow through deep yellow, orange to bright red, and are sold under a variety of names—primrose chrome, lemon chrome, chrome yellow, orange chrome, scarlet chrome, chrome red or Derby red (which has already been described under red pigments), etc. The base of all these pigments is the chromate of lead and its basic derivative.

The normal chromate of lead is a deep yellow colored body, and is obtained by precipitating a solution of bichchromate of potash with one of lead acetate. A lead solution is first prepared, a number of small wooden tubs placed one above the other being used for the purpose. The tubs are filled with granulated lead and after closing the cocks with which they are provided, vinegar is poured into the uppermost tub. After about 10 minutes the cork in the bottom of the tub is opened and the fluid allowed to run into the second tub, from there into the third, and so on. The tubs remain standing without vinegar until the lead is covered with a bluish white film. The uppermost tub then receives its charge of vinegar. After ½ to 1 hour the vinegar is discharged into the second tub, and so on until the saturated lead solution containing lead acetate arrives in the collecting tub. For the preparation of

chrome yellow the fluid is compounded with so much vinegar that it just begins to show an acid reaction, and it is then brought into a larger tub for clearing. In another tub a solution of 55 lbs. of bichromate of potassium in 500 quarts of water is kept in readiness. Lead liquor is then poured into the bichromate of potassium solution as long as a precipitate is formed. The precipitate is washed and dried. With the use of Glauber's salt (sodium sulphate) as a precipitant in connection with bichromate of potassium, almost any shade of yellow can be obtained; in fact, the shade of the pigment depends upon the proportion between the two precipitants. The more sodium sulphate is present, the paler will be the shade of yellow obtained, a fact which can be gathered by an examination of the following receipts:

Pure lemon yellow. Lead acetate 100 lbs. bichromate of potash 25, Glauber's salt 35.

Pure chrome yellow. Lead acetate 100 lbs., bichromate of potash 30, Glauber's salt 21.

Pure deep chrome yellow. Lead acetate 100 lbs., bichromate of potash 35.

American chrome yellow is made by using alum in the place of Glauber's salt. The product is a fine one, the alumina salt seeming to exert a beneficial influence on the fineness of the precipitate. The following are examples of the proportions generally used:

	Deep.	Medium.	Pale.
Lead acetate	120	100	100
Potassium bichromate.	20	20	20
Alum	100	100	100
Barytes	40	60	80
Gypsum	—	—	80

A cheaper class of chrome yellow is made by precipitating the chromate of lead on a white base, barytes, china clay and whiting being used for the purpose. When well made these are quite as good to use as the technically pure chromes, although the preference is given to the latter by most users.

Chrome orange. As with the yellows, no actually chemically pure oranges are made, the technically pure colors containing more or less sulphate of lead, while the common colors generally contain barytes. Pure chrome orange may be made as follows: Dissolve separately in water 100 lbs. of lead acetate, 35 lbs. of bichromate of potash or soda, and 9 lbs. of 77 per cent. caustic soda. Run the lead solution into a precipitating tank, then add the bichromate solution, whereby chrome yellow is precipitated. This is allowed to settle, the clear supernatant liquor drawn off, and then the caustic soda solution is added to the yellow. The mixture is heated until the desired shade is obtained. The orange is next allowed to settle, the supernatant liquor drawn off, the pigment two or three times washed with water and dried, when it is ready for use.

Common chrome orange is prepared as follows: Make a chrome yellow as described above from lead acetate 100 lbs., barytes 200, and bichromate of potassium 35, then add 10 lbs. of quicklime freshly slaked. Boil until the desired shade is developed, wash and dry the pigment. The shade of the orange is modified by the quantity of barytes which may be used in proportion to the other constitutents. The amount of alkali used and the length of boiling also have some influence. Gypsum or china clay may be substituted for barytes if required.

Pure chromes of medium and paler shades are so strong that when used for solid color, a considerable proportion of white lead may be mixed with them without materially affecting the tone. They are so strong in body that they may be worked out very thin and yet cover perfectly, so that in every way they are cheaper than the reduced ones.

Adulteration may be tested by tinting strength. Note carefully that the pale shades do not incline to a greenness in tone, for such are certain to blacken quickly, even when mixed with white lead. Also note the grinding, which should be perfectly fine; on glass. under the knife, not the faintest trace of grit should be found in the pure article. An abnormaliy bright chrome may be suspected of being adulterated with orange mineral. A good orange mineral really brightens an orange chrome, but is a dangerous element in it.

Zinc chrome is prepared either by precipitating a solution of zinc sulphate with a solution of chromate of potash, or by treating zinc oxide with either chromic acid or potassium bichromate.

Zinc chrome is a yellow pigment of good color and body. It is quite permanent, resisting exposure to light and air, when well made. It can be mixed with all other colors without being affected by them. It is not equal, as regards color and body, to lead chromes.

Barium chrome. The use of this pigment has become obsolete on account of its having only a very pale yellow color and its want of body. It may be prepared by precipitating a solution of barium chloride with potassium bichromate.

Turner's yellow, also known as *Cassel yellow*, *Montpelier yellow*, *Verona yellow*. This pigment is essen-

tially an oxychloride or basic chloride of lead. It is obtained by treating lead oxide with common salt solution, whereby white oxychloride of lead is separated. The latter is then washed, dried, put in a crucible and calcined at a gentle heat sufficient to melt the mass. The shade of yellow depends upon the temperature and duration of the heating.

Another method consists in fusing 1 part sal ammoniac with ten parts of lead oxide, whereby a yellowish foliated crystalline mass is obtained, which is triturated to a fine powder and washed.

Since the introduction of the chrome yellow, the use of this pigment has been almost entirely abandoned.

Naples yellow, is a compound of the oxides of antimony and lead. According to Brunner it is prepared by intimately mixing 1 part of chemically pure tartar emetic with 2 parts of nitrate of lead and 4 parts of common salt, fusing the mixture in a Hessian crucible and maintaining it at a moderate red heat for two hours. When cold the solid mass is taken from the crucible, extracted with water, whereby the common salt is dissolved out, when the pigment is dried. By treatment with very dilute hydrochloric acid an excess of lead oxide may be withdrawn from the pigment in order to give it greater depth and intensity of color.

A cheaper, but not so beautiful a product, is obtained by mixing 2 parts of an alloy of equal parts of lead and antimony with 3 parts of saltpetre and 4 of common salt, calcining the mixture, and washing.

According to the Paris process 12 parts of antimony are calcined, triturated with 8 parts of minium and 4 parts of zinc oxide, and the mixture is fused.

Naples yellow was at one time a favorite color with artists, but is now seldom used. It is bright, but not

in this respect equal to the chromes. They are fairly fast when exposed to light, but like all lead colors are affected by sulphureous gases.

King's yellow. This pigment is the trisulphide of arsenic. It was at one time in extensive use, as it is a very bright pigment, almost rivalling the chromes in beauty. It has a good body but is not a durable color, exposure to air causing it to fade. Furthermore, being an arsenic color it is very poisonous, and therefore, its use connot be recommended. It is found native as the mineral orpiment, which is sometimes ground up and used as pigment. Artificially the pigment is obtained by dissolving arsenic in hydrochloric acid and passing a current of sulphuretted hydrogen through the solution. A fine yellow precipitate is obtained, which is collected and dried at a gentle heat.

The pigment may also be obtained by sublimation, the process being as follows: Sublimed sulphur 1 part and white arsenic 2 parts are thoroughly mixed together and placed in a crucible. The latter is covered with another crucible or with a special condenser, and heated in a furnace. The arsenic and sulphur react and form the sulphide, which, being volatile, sublimes into the cover and is collected, washed and dried.

Realgar, arsenic orange. This is a native arsenic disulphide found in small quantities in various localities. It is artificially prepared by fusing together sulphur with an excess of white arsenic; or, on a large scale, by sublimation as follows: Mix 3 parts of arsenic, 2 of flowers of sulphur, and 4 of charcoal. A charge of 60 lbs. of this mixture is heated at a time in earthen crucibles so arranged that the product which sublimes can be collected. This sublimate is then remelted to form the pigment. Since the introduction

of the chrome yellows, the use of arsenic orange has been almost entirely abandoned.

Cadmium yellow. All the hues and tints, from the palest lemon cadmium to the fiery orange red, are due to one compound only of cadmium, namely the sulphide, which is represented by the formula CdS, and contains 112 parts by weight of cadmium to 32 parts of sulphur. As commonly prepared, cadmium yellow is of an orange hue; when this compound separates slowly from a solution, or is made in any way to take a dense or aggregated form, it becomes of a decided reddish orange. The orange-yellow variety, when very finely ground, becomes less red and more inclined to yellow. Some of the palest cadmium yellows contain white pigments or flour of sulphur, added to reduce their depth of color. Yellow cadmium is preprepared in several ways. A slightly acid solution of any cadmium salt is prepared and through it is passed a current of sulphuretted hydrogen gas. The product thus obtained has a pure chrome yellow shade. A lemon yellow shade may be obtained by dissolving 1 lb. of cadmium sulphate in 4 gallons of water and adding 1¼ gallons of the ordinary yellow ammonium sulphide.

Orange cadmium is prepared as follows: Make a solution of cadmium sulphate or chloride. Render the solution strongly acid by the addition of excess of hydrochloric acid, and pass through it a current of sulphuretted hydrogen gas.

All the precipitates of yellow obtained in the various ways just described must be thoroughly washed in water, especially those obtained with the ammonium sulphide, to free them from any trace of acid or sulphide, which, if left in, would ultimately lead to the

destruction of the color. After being washed they should be thoroughly dried at as low a temperature as possible, not exceeding about 150° F.

Pure cadmium yellow is one of the most permanent pigments known, it being unaffected by exposure to light and air. It mixes with any vehicle used in painting. When heated strongly the color darkens, changing to a dark violet-red; on cooling the original color comes back, but not always in its original brilliance.

Cobalt yellow, aureolin. This pigment is a compound of the nitrites of cobalt and potassium. It is prepared by precipitating cobalt nitrate with sodium carbonate, dissolving the precipitate in acetic acid and adding a strong solution of potassium nitrite. On allowing the mixture to stand for some time the color is gradually precipitated, and is collected, washed and dried, when it is ready for use.

Cobalt yellow is a pure yellow color, and is almost transparent whether used in water or oil painting.

Yellow ochre is a native pigment found in most countries. It varies considerably in constitution and color, in which latter particular it is found from a bright but not very vivid yellow to a brown yellow called *spruce ochre*, and is always of a warm cast. Its natural variety is much increased by artificial dressing and compounding. The best yellow ochres are not powerful, but as far as they go are valuable pigments, particularly in fresco and distemper, being neither subject to change by ordinary light, nor much affected by impure air. By time, however, and the direct rays of the sun, they are somewhat darkened, and by burning are converted into light reds. They are among the most ancient pigments, may all be pro-

duced artificially in endless variety as they exist in nature, and iron is the principal coloring matter in all. The natural ochres are prepared for use by grinding and levigating. The plant used for this purpose varies at different works, its construction being largely dependent upon the nature of the ochre which is treated. Some ochres are soft and powdery, these only require levigation; while others are harder and need to be ground before they can be levigated.

Oxford ochre is a native pigment from the neighborhood of Oxford, England. It is semi-opaque, of a warm yellow color and soft argillaceous texture, absorbent of water and oil, in both of which it may be used with safety. Similar ochres are found in the Isle of Wight, in the neighborhood of Bordeaux and various other places.

Stone ochre. True stone ochres are found in balls or globular masses of various sizes in the solid body of stones, lying near the surface of rocks. These balls are of a smooth compact texture, generally free from grit and of a powdery fracture. They vary exceedingly in color, from yellow to brown and gray, but do not differ in other respects from the preceding, and may be used in oil or water in the several modes of painting, and for browns and dull reds in enamel. Varieties of ochrous colors are produced by burning and compounding with lighter, brighter and darker colors.

Sienna, terra di Sienna, is also a ferruginous native pigment, and appears to be an iron ore, which may be considered as a crude natural yellow lake, firm in substance, of a glossy fracture, and very absorbent. The Roman siennas are found in hollows on hillsides, which hollows are now filled up with deposits of sienna, but at one time were the sites of small ponds

into which flowed streams highly charged with iron and manganese, from deposits of those materials situated above the ponds.

Siennas are sold in two forms, raw and burnt. *Burnt sienna* is prepared by calcining the raw sienna at a moderate red heat until it has acquired the desired shade. Burnt sienna is richer in color, deeper and more transparent, and works and dries better than raw sienna.

Orange ochre, also called *Spanish ochre*, etc., is a very bright yellow ochre, burnt, by which operation it acquires warmth, color, transparency and depth.

Mars orange is an artificial ochre similar to the above. It is made by taking equal weights of ferrous sulphate and alum, and adding a solution of carbonate of soda, thereby precipitating the iron and alumina. The precipitate, which forms a yellow pigment, the so-called Mars yellow, is collected, washed well with water, dried and converted into orange, by slightly calcining.

Indian yellow or Purree. This remarkable pigment is obtained at Monghyr, a town in Bengal, from the urine of cows which have been fed upon mango leaves. It generally occurs in the form of large balls, having an offensive urinous odor.

Indian yellow is an impure magnesium salt of euxanthic acid. The essential part of it is a compound containing 4.5 per cent. magnesia, 18.7 per cent. water, and 78.7 per cent. euxanthic anhydride; but this substance is always associated, even in the most carefully purified samples of prepared Indian yellow, with various impurities both mineral and organic.

For artistic purposes the crude imported Indian yellow is thoroughly powdered, and then washed with

boiling water until the liquid filtered from it is no longer colored; a brown impurity and much of the evil smell is thus removed. The color of the washed product is enriched by leaving it in contact for a day or two with saturated solution of sal ammoniac, and then repeating the treatment with hot water.

CHARACTERISTICS OF YELLOW AND ORANGE PIGMENTS.

Names and composition of pigments.	Behavior			Special characteristics.
	Towards hydrochloric acid.	Towards caustic soda lye.	On heating before the blow-pipe.	
Chrome yellow and chrome orange.	Green solution with a white sediment, which disappears on diluting if no foreign white bodies are present.	Orange, soluble with a yellow color on boiling, frequently with a white residue.	Red-brown, fusible, yields upon coal with soda metallic lead grains.	Poisonous.
Turner's yellow, (Cassel yellow.)	Unchanged in the cold; white on heating.	Becomes paler on heating, with the formation of a wine-yellow fluid.	White vapor, yellow film and metallic lead grains upon coal.	Poisonous.
Naples yellow.	On heating first orange, then white.	Reddish yellow.	White vapor, brittle grains upon coal.	Poisonous.
King's yellow.	Unchanged.	Soluble; is again separated by acids.	Volatile, white vapor; odor of sulphurous acid and garlic.	Soluble in ammonia, nearly colorless. Poisonous.
Ochre and siena.	Yellow solution, white residue.	Becomes brownish.	Red to brown.	A solution in hydrochloric acid is colored blue by prussiate of potash.
Barium chromate, zinc chromate.	Soluble; white precipitate with sulphuric acid.	Unchanged; zinc chromate gives a yellow fluid.	Slightly changed, becomes green in the reducing flame.	Slightly poisonous.
Indian yellow, or Purree.	Pale yellow and effervescent.	Dark yellow.	White ash containing magnesia.	Non-poisonous.

Green Pigments.

There are quite a large number of green pigments derived from both natural and artificial sources, but usually from the latter. The following are some of the principal greens:

Brunswick green. Under this name will first be described the old Brunswick green, which is a basic chloride of copper. Its use has become almost obsolete, it having been supplanted by the modern Brunswick green, which will be described later on. The old Brunswick green is prepared as follows: Bring 10 lbs. of copper turnings in a vessel which can be closed; over them pour a solution of 15 lbs. of ammonium chloride in 3 gallons of water. Close the vessel and mix the contents by shaking. Keep the vessel in a warm place for about two months and at intervals mix the contents by shaking. At the end of the time the vessel is opened, when it will be found that most of the copper has been converted into the green oxychloride. The green is collected by washing it with water to free it from any alkaline bodies, sieving to free it from unchanged copper, and drying slowly at a low temperature, since high temperatures tend to decompose it. It is necessarily somewhat costly. It works well both in oil and water and has a good covering power. As previously stated, it has been almost entirely superseded by the

Modern Brunswick greens. These pigments can be made in various ways, almost every color-maker having his own method of mixing the various ingredients. By the *dry method*, the materials composing the green are thrown into the pan of an edge-runner grinding-mill or into a mixing-mill. For producing the various shades of Brunswick green the following proportions may be used:

Constituents.	Brunswick green.			
	Pale.	Medium.	Deep.	Extra Deep.
	lbs.	lbs.	lbs.	lbs.
Barytes	110	110	110	110
Prussian blue	1½	2½	5	8
Chrome-yellow	35	35	35	35

Gypsum in the proportion of 1 to 2½ of barytes may be substituted for the latter.

For producing the various shades of Brunswick green by the wet method, the following proportions may be used, which, as well as those given above, may be varied so as to suit special requirements. In making alterations in the proportions, care should be taken to use equal weights of prussiate and copperas, and to have the proportion of acetate of lead to the bichromate of potash as nearly as possible 10 to 3½.

Constituents.	Brunswick green.			
	Pale.	Medium.	Deep.	Extra Deep.
	lbs.	lbs.	lbs.	lbs.
Barytes	110	110	110	110
Acetate of lead.	13	13½	14	16
Copperas	1	1½	2	4
Yellow prussiate of potash	1	1½	2	4
Bichromate of potash ·	4	4¼	4½	5

Dissolve the iron salt in a tank of cold water, and

the lead salt in another tank; the two potash salts may be dissolved together in one tank. Mix the barytes with water in another tank, and when properly mixed run in the iron solution, with constant stirring, and then add the lead solution. After the latter has been run in and mixed with the rest, add the solution of the potash salts, stirring constantly. The green soon forms and is allowed to settle. The clear supernatant liquor is then drawn off, and the pigment repeatedly washed with water. It is then thrown on filters to drain, and finally dried at a moderate heat.

The pigments, above described, work well in both oil and water. They are sold under various names such as chrome green, Victoria green, Prussian green, etc., but they are best known as Brunswick green. They are quite permanent for all practical purposes.

Chrome Green. This pigment consists of the oxide of chrome Cr_2O_3. A beautiful but expensive product is obtained in the form of a very delicate, generally very dark green powder, by heating mercurous chromate under the exclusion of air. According to Guignet's process chrome green, or *Guignet's green* as it is sometimes called, is obtained by fusing together at a red heat 1 part potassium bichromate and 3 parts of boric acid, lixiviating the fused mass with water and grinding.

Arnaudon's green is the phosphate of chromium, Cr_22PO_4. It is prepared by heating in a dish 128 parts of neutral crystallized ammonium phosphate and 149 parts of potassium bichromate to from 338° to 356° F., but not exceeding 392° F., until the mixture has acquired a beautiful green color, and washing the mass with hot water. The pigment resists acids, alkalies

and sulphuretted hydrogen. Instead of phosphoric acid, arsenic acid is occasionally found in the combination; this renders the pigment more beautiful, but also very injurious.

Plessy's green. This pigment is prepared as follows: Dissolve 2 lbs. of potassium bichromate in 10 quarts of boiling water, add 3 quarts of a solution of calcium phosphate and 2½ lbs. of cane sugar. A violent evolution of gas takes place, which is moderated by pouring water on the froth. The pigment will have settled by the next day, when the supernatant fluid is drawn off and the precipitate washed with cold water until all acid reaction has disappeared. It is finally dried at a moderate heat. The pigment resists the action of light, sulphuretted hydrogen and acids. It works well, both in oil and water.

Schnitzer's green is obtained by dissolving 15 parts of potassium bichromate in 36 parts of sodium phosphate, melted in its water of crystallization, and adding 6 parts of tartaric acid. Effervescence takes place and the color of the melting mass passes from yellow into green. The residue is moistened with as much hydrochloric acid as it will absorb, then washed, first with cold, and next with boiling water, pulverized, levigated and dried.

Verdigris, or acetate of copper, occurs in commerce as neutral or crystallized verdigris and as basic or common verdigris. The neutral or crystallized verdigris is neutral acetate of copper, which was originally prepared by the Dutch, who, to mislead other manufacturers, called the preparation *distilled* verdigris, under which name it is now generally known. It is very rarely used as a pigment, on account of its crystalline nature. It is prepared by dissolving copper

or oxide of copper in acetic acid obtained in the distillation of wood.

The basic, or common verdigris, is of the most importance from the painter's point of view. In France it is prepared by placing the skins and marcs of grapes, left after the juice has been pressed out for making wine, in large tubs, loosely covered with netting. In a few days, when acetic fermentation sets in, sheets of copper are thrown in. They are left in the tubs among the grape skins for 18 to 20 days, when the tubs are emptied and the grape refuse thrown away. The copper sheets are dried, then dipped into water and again dried. By this means a coat of verdigris is formed on the plates, which is scraped off. The plates are re-dipped, when another coating of verdigris is formed and scraped off as before, the process being repeated until all the copper has been converted into verdigris. The green is washed with water and then dried, when it is ready for use.

Verdigris has a greenish-blue color. It is fairly permanent in oil, but it soon fades in water.

Scheele's green, or mineral green, consists essentially of cupric hydrate and cupric arsenate, and, according to Sharples, has the formula $Cu_2As_2O_6.2H_2O$. It is obtained by mixing, with constant stirring, a solution of 6 parts of pure sulphate of copper, free from iron, with a solution of 2 parts of arsenic acid and 8 parts of crystallized soda. The grass-green precipitate formed is washed with warm water and dried.

Scheele's green is of a pale yellowish-green color, but not very bright. As a pigment it is not satisfactory, its covering power being small. It is not permanent, and fades on exposure to light and air.

Although under the name of mineral green are, as a

rule, understood the paler varieties of Berlin blue mixed with clay, or kaolin, etc., the natural green mineral, known as malachite, is also offered under this name and that of *mountain green* for use as a pigment. Malachite is a natural basic carbonate of copper, and is found in many places. For use as a pigment it is simply ground as finely as possible. It makes a good pigment, is fairly permanent, and works well both in oil and water.

Schweinfurth green, or emerald green. The name Schweinfurth green is derived from the place where the pigment is supposed to have been first made, while in this country it is generally known as "*Paris green*," under which name it is largely consumed as an insecticide. It is the most beautiful of all copper pigments, but also the most injurious to health. It is an aceto-arsenite of copper of somewhat variable composition, according to the process by which it has been made. For its preparation Ehrmann dissolves separately equal parts of white arsenic and neutral verdigris in water, and mixes the boiling hot concentrated solutions. A flaky olive green precipitate of arsenite of copper is immediately formed while the liquor contains free acetic acid. By allowing the precipitate to stand quietly in the liquor, it becomes dense and crystalline, green spots, which gradually become larger, being at the same time formed in it, until, in the course of a few hours, it is completely converted into an intensely green, granular, crystalline mass. The pigment thus formed is filtered off and washed with boiling water.

According to Braconnot 30 lbs. of sulphate of copper are dissolved in as small a quantity of boiling water as possible, and the hot solution is mixed with a hot con-

centrated solution of arsenite of soda, or of potash, which contains 40 lbs. of white arsenic. A dirty green precipitate is immediately formed. By adding to the fluid 15 quarts of concentrated wood vinegar, the precipitate is converted into Schweinfurth green, which, to prevent the separation and admixture of arsenic, is immediately filtered off and washed with boiling water.

Schweinfurth green is a bluish-green of a very fine tint, quite different from any other pigment and very difficult to imitate. It has good covering power and works well in both oil and water. It resists exposure to the light and air, but in a damp place it turns brownish. The use of Schweinfurth green has been on the decrease of late years, partially owing to its poisonous character, due to its containing arsenic.

Bremen green is essentially copper hydrate, and forms an extremely loose and pale blue mass, the color of which has, however, a somewhat greenish tinge. When used as a water color it gives a pale blue, but when employed as an oil paint the original blue color turns green in 24 hours, owing to the copper oxide combining with the fatty acids of the oil to a green copper soap.

For the preparation of Bremen green 112½ lbs. of common salt and 111 lbs. of sulphate of copper are ground with water to a stiff paste; this results in the formation of chloride of copper and sulphate of soda. With the paste are mixed 112½ lbs. of clean copper in small pieces about 1 cubic inch in size. All these are thoroughly mixed together and kept in wooden boxes or tubs. At intervals of two or three days the mass is turned over with a wooden spade, so as to insure that the metal and paste are brought into intimate contact

with one another. In about three months all the copper will have been converted into a green basic oxychloride of copper. The latter is insoluble in water, and, after it has been formed, the mass is thrown into tubs and thoroughly washed with water, whereby all the soluble alkaline compounds are washed out.

If the pigment is to be converted into *Bremen blue*, the green is mixed with a small quantity of hydrochloric acid and allowed to stand for 24 hours. To the pasty mass is then added about 2½ times its volume of caustic soda at 40° Tw., which is thoroughly mixed with it. The mass is then allowed to stand for 36 to 48 hours, by which time it will have been converted into the required blue. It is now thoroughly washed with water to free it from soda, and dried, when it is ready for use.

Casselmann's green is prepared by mixing a boiling hot solution of sulphate of copper with a boiling solution of an alkaline acetate. The precipitate formed is a basic copper oxide salt, having the formula $CuSO_4.3Cu(OH_2).4H_2O$. Dried and triturated it forms Casselmann's green, which, next to Schweinfurth green, is the most beautiful of all copper colors.

Stannate of copper, or Gentele's green is prepared by precipitating sulphate of copper with sodium stannate, and washing and drying the precipitate. It is a beautiful, non-poisonous green pigment.

Terre verte is the name given to an ochre of a bluish-green color, not very bright, moderately hard, and smooth in texture. In some cases the pigment has been named after its place of occurrence, as *Verona green, Verona earth, etc.* These natural greens are useful on account of their permanency, they being un-

affected by strong light and impure air, and combining with other colors without injury.

Terre verte is found in masses of a more or less compact character. Some varieties are soft and easily powdered, others are harder and more vitreous in appearance. For use as a pigment the mineral is ground up as fine as possible. The pigment mixes well with either oil or water. Heat turns its color to a reddish-brown, the change being similar in nature to that which takes place when ochres are heated.

Rinmann's green, cobalt green, or zinc green, is a compound of the oxides of zinc and cobalt, and is prepared as follows: Dissolve nitrate of cobalt 1 lb., or chloride of cobalt ½ lb., and sulphate of zinc 6 lbs. in 7 gallons of water. Then add solution of carbonate of soda as long as a precipitate falls. Filter the mixture and wash the precipitate of hydroxides of cobalt and zinc thus obtained. The precipitate is finally dried and heated at a bright red heat in a muffle furnace for a few hours, until the green has been fully developed.

Cobalt green has a bright green color, of a slightly yellow hue. It is perfectly permanent when exposed to light and air, and is, on that account, a useful pigment, but owing to its cost it is not much used.

Sap green is prepared from buckthorn berries, as follows: The berries are allowed to ferment slightly by placing them in a warm place for a few days. They are then pressed, the juice is collected and alum added in the proportion of from ½ oz. to 1 oz. per pound of juice. The mixture is then boiled down and evaporated at the boiling heat.

Sap green is a dark yellowish pigment. When dry it breaks with a glossy fracture. It is chiefly used as a glazing color.

CHARACTERISTICS OF GREEN PIGMENTS.

Names and composition.	Behavior: Towards hydrochloric acid.	Behavior: Towards caustic soda lye.	Behavior: On heating before the blowpipe.	Special characteristics.
Rinmann's green, cobalt green, zinc green.	Unchanged.	Unchanged.	Unchanged.	Non-poisonous when free from arsenic.
Ultramarine green; composition similar to that of ultramarine blue.	Destroyed, with evolution of sulphuretted hydrogen.	Unchanged.	A superficial red-brown coloration with the access of air and a strong heat.	Non-poisonous.
Guignet's green, oxide of chrome.	Green solution.	Unchanged.	Unchanged.	Non-poisonous.
Bremen green, oxyhydrate of copper, frequently mixed with gypsum. (a.) Brunswick and mineral green. (b.) Verdigris, basic acetate of copper. (c.)	Yellowish-green solution and white residue with *a* and *b*.	Becomes black by boiling.	Becomes black, the flame acquiring a green color; reduction of copper with soda upon coal.	A solution in hydrochloric acid yields, with caustic ammonia, a deep blue coloration. Evolution of vapors of acetic acid when *c* is boiled with hydrochloric acid. Poisonous.
Scheele's green. Schweinfurth green, emerald green, Paris green.	Yellow-green solution.	Becomes bluish; when heated, red to orange-red, or yellow.	Black, fuses when pure; evolves an odor of garlic and colors the edge of the flame green.	Very poisonous.
Zinc green (Prussian blue and chrome yellow).	Blue-green solution with the separation of white crystals.	Becomes yellow.	Brown or brown-yellow residue. Grains of lead upon coal.	Slightly poisonous.
Terre verte, Verona green, Verona earth.	Brownish-yellow solution on heating.	Somewhat darker.	Brown red.	Non-poisonous.

Blue Pigments.

Although blue is a very important color, there are but few blue pigments, but these possess the merit of being more permanent and, therefore, more useful than any other group of pigments. One of the most important pigments possessed by the painter is

Ultramarine, a magnificent blue color, which was formerly extracted from the mineral known as *lapis-lazuli*, which is found of very varying purity and color in Siberia, Transylvania, in the Andes, and in several regions of Persia, Thibet and China. To prepare a pigment from this mineral, selected pieces of small size, as free as possible from pyrites and other impurities, are heated in a crucible and quenched in cold water, or very weak vinegar. The mineral, thus disintegrated, is washed by decantation, then dried and carefully ground. The powder is then purified by elutriation, the several wash waters depositing pigments of different depths of color and of different degrees of fineness. Very little of this natural ultramarine is now produced, it having been almost entirely replaced by the

Artificial ultramarine. By the chemical analysis of lapis-lazuli an accurate knowledge of its composition was obtained, which finally led to the production of artificial ultramarine. In 1828 Guimet, an eminent French manufacturing chemist, succeeded in making it on a large scale. His process is still used by his successors, but has not been published. Gmelin also interested himself in the production of ultramarine, and, in 1828, published an elaborate description of his method of making it. About 1834, Dr. Leverkus started its manufacture in Germany at works which are still in existence. There are two varieties of artificial ultramarine, green and blue. The green variety

may be converted into blue, either by a roasting process or by the addition of sulphur. As regards the process of manufacture three different kinds of ultramarine may be distinguished: 1. *Sulphate ultramarine;* 2. *Soda ultramarine;* and 3. *Silica ultramarine.*

For the preparation of sulphate ultramarine, mixtures of kaolin (free from water), calcined sodium sulphate, coal or charcoal and sulphur, are heated in closed chamotte crucibles to a bright red heat. The proportions of the above-named substances, as generally used, may be seen from the following examples:

	I.	II.
Kaolin (free from water)	100	100
Calcined sodium sulphate	83 to 100	41
Calcined soda	—	41
Coal	17	17
Sulphur	—	13

The product obtained by heating is levigated, pulverized, washed and dried, and then forms a green powder, which is sold either as green ultramarine or is converted into blue.

The conversion of green ultramarine into blue is effected in various ways. Generally the green ultramarine is mixed with sulphur and roasted at a low temperature, so that the sulphur may burn to sulphurous acid and a portion of the sodium sulphate is oxidized, the latter being extracted by washing the blue ultramarine which is formed. The roasting is effected in small cylindrical vessels imbedded in brickwork over an ordinary fire-place. These cylinders are closed at the back end, but open in front, which is fitted with a door made of wrought iron. In this door are two

apertures for the purpose of charging the cylinder with sulphur, while a pipe from the top of the cylinder carries off the gases produced by the burning of the sulphur. An agitator is fitted to the cylinder, by means of which its contents can be kept well mixed during the progress of the operation. When the contents of the cylinders have been sufficiently heated to ignite sulphur, the fire is moderated, and sulphur thrown in and allowed to burn. This treatment with sulphur is continued until the ultramarine shows the desired blue color. According to other methods roasting is effected in a muffle furnace or upon trays in a furnace of special construction.

After roasting, the ultramarine is washed, the sodium sulphate passing into the wash water and is gained as a by-product. The washed ultramarine is ground fine and by elutriation sorted into various degrees of fineness. Different kinds of ultramarine showed the following compositions:

	I.	II.	III.
Silica	40.25	39.10	38.95
Alumina	26.62	26.72	25.87
Sulphur	13.42	12.35	13.91
Soda	19.89	21.83	21.27

In the preparation of *soda ultramarine*, mixtures are used which contain little or no sodium sulphate, but soda instead of it.

There is but a very slight difference between sulphate and soda ultramarine. If more soda than sodium sulphate is used the product is called soda ultramarine, and sulphate ultramarine if more sodium sulphate than soda is employed.

The following proportions may be used:

Kaolin	100	100	100
Sodium sulphate	—	41	—
Soda	100	41	90
Coal	12	17	6
Sulphur	60	13	100
Colophony	—	—	6

The heating or roasting is effected in glass-pots, or, better, in a reverberatory furnace. A white mass, the so-called *ultramarine mother*, is at first obtained, after which a green, porous product results, which, on cooling, absorbs oxygen and is mostly converted into blue ultramarine.

For the complete conversion into blue ultramarine it is finally subjected to a roasting process with sulphur in large muffles. The white ultramarine mother and the blue ultramarine show the following composition:

	White ultramarine.	Blue ultramarine.
Silica	40.26	38.68
Alumina	29.69	27.70
Soda	24.38	16.56
Alumina soluble in water	—	2.04
Sodium chloride	—	10.63
Sulphur (total)	6.89	6.09
Sulphur separable as sulphuretted hydrogen	3.81	2.00

It may here be mentioned that the white ultramarine mother can also be converted into blue ultramarine by treatment with anhydrous sulphuric acid, hydrochloric acid free from water, chlorine, carbonic acid, and bisulphide of carbon.

Silica ultramarine. For the preparation of this product 5 to 10 per cent. of the weight of kaolin used of finely divided silica is added to the above-mentioned mixtures for soda ultramarine. The resulting ultra-

marine is blue. This product differs from the previously described varieties of ultramarine in possessing a peculiar reddish color and resisting the action of an alum solution which decomposes the other two varieties.

The ultramarine blue obtained by roasting or calcining is mixed with water in a tub, and steam is then introduced until the water boils. The ultramarine is then allowed to settle, when steam is again introduced until the water boils. After several times repeating this operation the ultramarine is ground, elutriated and dried in enameled pans. The dried mass is again ground and bolted, or sieved. Ultramarine may also be prepared in the wet way, but the method has thus far not been a technical success.

Violet ultramarine. H. Zeltner, of Nüremberg, makes violet ultramarine by submitting either the green or blue varieties to the temperature of about 572° F. and passing chlorine gas over them. At first the color, if the blue is used, turns green, and then it becomes dark red. At this point the operation is stopped and the red product is boiled in an alkaline solution until it turns violet, after which it is washed.

Red ultramarine. In Marienberg, Germany, red ultramarine is directly obtained from ultramarine blue, rich in silica, by the action of hydrochloric acid and air. Zeltner prepares it as follows: The blue variety is exposed at a temperature of from 266° to 302° F. to the action of nitric acid vapors, when he obtains deep or dark red, or light rose or pink shades, according as the acid vapors are dilute or strong.

As a pigment ultramarine is perfectly permanent when exposed under all ordinary conditions, it being fast in light and air, the only destructive agents being

acid vapors, which rapidly decolorize it. It can be mixed with all the ordinary vehicles used by painters, and with most other pigments, without being changed thereby or itself causing any change. Blue ultramarine is distinguished by its pale but pure tone and by its tint of blue being quite different from that of all other blue pigments.

Prussian blue, Berlin blue, or Chinese blue. In commerce several varieties of Prussian blue are sold under the names, *Chinese blue*, *Prussian blue*, *soluble blue*, *Antwerp blue*, *Brunswick blue*, etc. Chinese blue, the name given to the best quality, is a blue of a greenish shade, and is prepared as follows: Dissolve 10 lbs. of ferrous sulphate (green copperas), as free as possible from oxide, in cold water, and add to the solution 1 lb. of sulphuric acid. This solution must be made as required, as it soon begins to oxidize and to deposit oxide of iron. Next dissolve 10 lbs. of yellow prussiate of copper in water. The solutions should be made as dilute as possible, not less than 3 to 3½ gallons of water for every 10 lbs. of material; even weaker solutions are preferable, as these yield finer precipitates than strong solutions, and thus facilitate the production of the lustre on the finished blue.

On mixing the solutions a bluish-white precipitate is obtained, which is allowed to settle when the supernatant clear liquor is drawn off. To the blue remaining is added first a thin cream of 2 lbs. of bleaching powder with water, which is thoroughly mixed with the precipitate, and then a small quantity of hydrochloric acid, and the blue color gradually develops. It is allowed to settle; the supernatant liquor is then run off, and the blue thoroughly washed with water and drained on a filter. The wet mass is then pressed

into drying pans and slowly dried in the dark at a temperature not exceeding 120° to 130° F.

Chinese blue is generally sold in the form of small cubical lumps, but is also found in commerce in the form of fine powder. In grinding the blue great precaution is required to exclude particles of iron, as the production of a spark will ignite the dry powdered blue and reduce it to a mass of red oxide of iron.

There are several ways of making the commoner kinds of Prussian blue, one of which will suffice as an example. Dissolve 10 lbs. each of yellow prussiate of potash and copperas in about 5 gallons of water, mix the two solutions, allow to settle, pour off the clear supernatant liquor, wash the color with water, then throw it on to the filter and allow it to be exposed to the air until it has acquired the desired shade.

Soluble Prussian blue. While the varieties of Prussian blue above described are insoluble in water and acid, a blue soluble in water may be prepared as follows: Prussian blue is treated with hydrochloric acid or concentrated sulphuric acid for one or two days, then thoroughly washed with water, dried and dissolved in oxalic acid. The most suitable proportions for preparing a durable solution are 8 parts of Prussian blue treated with sulphuric acid, 1 part of oxalic acid and 256 parts of water.

Turnbull's blue. By mixing a solution of red prussiate of potash with one of green copperas, the quantity of which, however, is insufficient for the decomposition of the red prussiate of potash, a precipitate consisting essentially of potassium ferro-ferric cyanide. According to Gintl, Turnbull's blue is nothing but Prussian blue.

Brunswick blue. This pigment is essentially a mix-

ture of Prussian blue and barytes. It is prepared by thoroughly mixing barytes with water, adding a solution of copperas, then a solution of red or yellow prussiate of potash, stirring constantly so as to ensure the thorough incorporation of the barytes with the blue. After filtering, washing and drying, the blue is ready for use.

Prussian blues are characterized by their greenish-blue tint. Dry pure Prussian blue has a pure color and bronzy appearance. It is insoluble in water and is decomposed by alkaline solutions and concentrated acids as well as by heating. The lighter and looser it is, the better it is. In an air-dry state it still contains more than 20 per cent. of water. As a pigment it is quite permanent and resists exposure to the air, light, and most of the other influences which act on pigments. It has the curious property of fading a little on exposure to light and of recovering its original intensity of color in the absence of light.

Prussian blue can be mixed with nearly all other pigments without being affected or changed by them or affecting them in any way.

Cobalt blue. With the exception of smalt, which owes its color to a cobalt silicate, there are at least three pigments known under the name of cobalt blue. The best known of these is a combination of alumina and cobalt oxide; then comes Leithner's or Thénard's blue, which is a cobalt phosphate on an aluminous base; lastly there is an aluminous cobalt arseniate very much like the phosphate.

Smalt. By fusing zaffre (impure cobalt oxide) together with silica and potash, a deep blue glass is obtained which in a finely ground state is known as smalt. On a large scale smalt is prepared by fusing

partially roasted cobalt ores with a mixture of powdered quartz and pearl ash. A silicate of potash is thus formed in which the cobalt oxide dissolves with the formation of a bright blue color. The mass while still hot is thrown into water and is ground to powder under granite stones. The finely ground powder is brought into tubs filled with water and allowed to settle. By repeated grinding and washing the different varieties of smalt are prepared. The best kind of smalt, i. e., the one richest in cobalt, is called King's or Royal blue. Smalt is principally used by paper stainers, and to some extent as a pigment. The price varies according to the number and degree of fineness, some varieties, for instance, costing only $6.00 per 100 lbs., while others cost as much as $45.00 per 100 lbs.*

Thénard's blue, or Leithner's blue, may be prepared by mixing about 8 parts of aluminium hydrate with 1 part of cobalt phosphate, both in a moist condition, then drying and strongly calcining the mixture; cobalt arseniate may be substituted for the phosphate. Another variety of Thénard's blue is obtained by adding sodium phosphate solution to a solution of alum containing a little cobalt sulphate. The materials used should be entirely free from iron and nickel to ensure the purity and beauty of the blue pigment formed.

Caeruleum, cerulean blue. When oxide of tin is moistened with cobalt nitrate solution and strongly heated, a greenish blue mass is obtained, which, after powdering and washing, constitutes one of the varieties of the pigment known as caeruleum. There are other ways of preparing this substance. One of these

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*German prices, according to Heinzerling "Chemische Technologie," 1888.

consists in precipitating potassium stannate with cobalt chloride, collecting and washing the precipitate, and then mixing it with some pure silica and heating it.

Caeruleum is a permanent pigment of a rather greenish-blue color, without any tendency to the violet cast, so noticeable with other cobalt blues when viewed by gas or candle-light.

Mountain blue. This blue pigment, the *azurite* or *blue malachite* of mineralogists, is found native in large crystals belonging to the monoclinic system. It is essentially a basic carbonate of copper, and has the composition $2CuO_3.CuH_2O_2$. For use as a pigment the mineral is ground up very fine. It is not much used.

Brown Pigments.

Umber. This pigment is one of the stand-byes of the painter. It owes its coloring to iron oxide and manganese oxide, and to the latter its drying property. Its other constituents are the same as ochre and sienna; in fact, these three pigments form a natural group of yellow to brown colors, having the ochres at one end of the scale and the umbers at the other, while between the two extremes all or nearly all the intermediate shades are found.

Raw umber is found native in several localities; the best variety has come for some time past from Cyprus. In this country it is found in many places. It occurs in veins and layers, of varying thickness, in rocks of all geological ages. It varies somewhat in hue from a reddish-brown to a violet-brown, the latter hue being characteristic of the Cyprus product, or *Turkey umber*, as it is generally called in commerce. For use as a pigment umber is finely ground, washed with water,

and then dried at 212° F., or at a slightly higher temperature.

Raw umber is rarely adulterated, though barytes is sometimes added to make the grinding in the mill an easier task and to reduce the proportion of oil in the paste, the oil being the most costly element.

Burnt umber is raw umber calcined at a red heat in a furnace, by which treatment the color becomes darker and warmer; the change which occurs being similar to that which ensues when ochres and siennas are calcined.

Vandyke brown. This pigment was much esteemed and used by the celebrated painter Vandyke, whose name it bears. It is a species of peat or bog earth of a fine, deep, semi-transparent, brown color. Sometimes it is named after the locality in which it is found, as, for instance, *Cassel earth.* For use as a pigment such natural product simply requires to be ground as fine as possible.

Vandyke brown is also prepared by slightly calcining cork cullings and waste, bark and twigs of trees and other organic matter in a closed vessel. Such Vandyke brown has a warm brown color of a reddish hue. It mixes very well with oil and water, and can be used for all kinds of painting.

Most of the common Vandyke browns are made by mixing together lampblack, vegetable black, or other black pigment, with red oxide and a little yellow ochre, the proportions used varying according to the quality and shade of the oxide used and whether ochre is also employed. Vandyke browns thus made, and containing from 36 to 50 per cent. of black (chiefly lampblack), form the great bulk of these pigments as used by the house-painter. This variety of brown forms a permanent pigment, and works well in oil.

Cappagh brown, or *euchrome*, is a native manganese brown found at Cappagh, near Cork, Ireland. It is a bog earth, or peat, and contains ferric hydrate and ferric oxide, with a considerable amount of one of the oxides or hydrates of manganese. In composition and general character it resembles raw umber, but has a more reddish hue.

Cappagh brown works well in oil, particularly if it be dried at a heat below that of boiling water before it is ground in oil. It is a permanent pigment.

Manganese brown is an oxide of manganese, of a fine, deep, semi-opaque brown, of a good body, and dries well in oil. It is artificially prepared from the waste still-liquors of the chlorine manufacturer by precipitating the liquors with sodium carbonate, collecting the precipitate and calcining in a furnace to a low red heat, until samples taken out and allowed to cool show the desired shade. It is a good and permanent pigment, but it is difficult to use on account of its excessively strong drying properties.

Sepia. This is a brown pigment, of slightly varying hue, and is obtained from various species of cephalopodous animals, such as *Sepia officinalis*, *S. loligo*, etc. It is a blackish-brown pigment of a very fine texture, mixing well with both oil and water. It is much used by artists, especially for monochrome work. It is a fairly permanent pigment, being but little affected by exposure to light and air.

Cologne earth is a soft, impure variety of brown coal or lignite. When slightly roasted a part of the brown organic matter in this earth is charred, or carbonized, and the substance becomes darker and duller, but also less alterable by exposure.

Bone brown is made by gently calcining bones until

they acquire a brown color. It resembles bone-black in composition, but contains some undecomposed animal matter. It is not much used.

Bistre. This pigment is prepared from the tarry soot of certain woods, especially from that of beech-wood, by the following process: The soot is finely ground and sifted and then the powder is digested with successive portions of hot water until the latter no longer acquires a brown or yellow tint. The washings are then evaporated with suitable quantities of gum water and glycerin, and the residue preserved in a moist state. To form cake-bistre the glycerin is omitted, but more gum is employed. Bistre is not used as an oil color. It has a fine warm brown color of a yellowish hue.

Black Pigments.

Most of the black pigments in use are produced by charring, and owe their color to the carbon they contain. Such blacks are known under a variety of names. Lamp-black, vegetable black, carbon black are almost, especially the last two, pure carbon, while animal-black, bone-black, ivory-black and Frankfort-black are blacks prepared from animal and vegetable matters and contain various other constituents besides carbon. All forms of carbon blacks are perfectly permanent pigments, they being unsurpassed in this respect by any other pigment. They can be mixed with all other pigments without bringing about any alteration.

Lamp-black. This is probably the most common and most used of the black pigments, and essentially is a kind of soot. When a combustible body such as oil, fat or grease is burnt under such conditions as to

preclude complete combustion, then a large volume of smoke is produced, and this deposits a black soot on any surface it may come in contact with. Such soot has a very black color, and is highly prized as a pigment. Lamp-black has derived its name from the fact that the earliest convenient means of producing this black was by burning oil in a lamp under conditions which would ensure that the combustible matter would not be completely burned. Very little lamp-black is now made in this way, chiefly because materials are now used in its preparation which cannot be burned with good results in a lamp.

The materials used in the manufacture of lamp-black and vegetable-black are very varied, and comprise American colophony, ozokerite and the combinations rich in carbon, which are obtained in the refining of petroleum and the distillation of brown coal. Further fish oil, ordinary or rancid vegetable oils, light and heavy coal tar oils, wood tar oils, greases, in fact anything that will yield a great deal of black smoke while burning, preference being given to those materials which are cheapest and least available for any other purpose. As regards the use of vegetable oils it may be mentioned that very rancid oil yields most carbon or soot, for experience has shown that such oil requires a larger quantity of oxygen for combustion without a sooting flame than non-rancid oil.

The process of manufacture of lamp-black consists essentially in burning the material and collecting the soot. Hence the plant required for the purpose consists of two parts, viz., the space in which combustion takes place, and the parts which serve for collecting the soot (the soot chambers).

The arrangements for the production of lamp-black vary according to the nature of the material to be used. Fig. 5 shows Thenius' furnace for the production of lamp-black. The material used consists of the oil last obtained in the distillation of coal tar and freed as much as possible from naphthalene. In this furnace, in the compartment *a* is an iron plate which is constantly kept at a red heat. Upon this plate the oil is allowed to fall in drops through the pipe *c*. The oil is decomposed, the smoke (soot) passing through small apertures *f* into the chambers 1, 2, 3, 4.

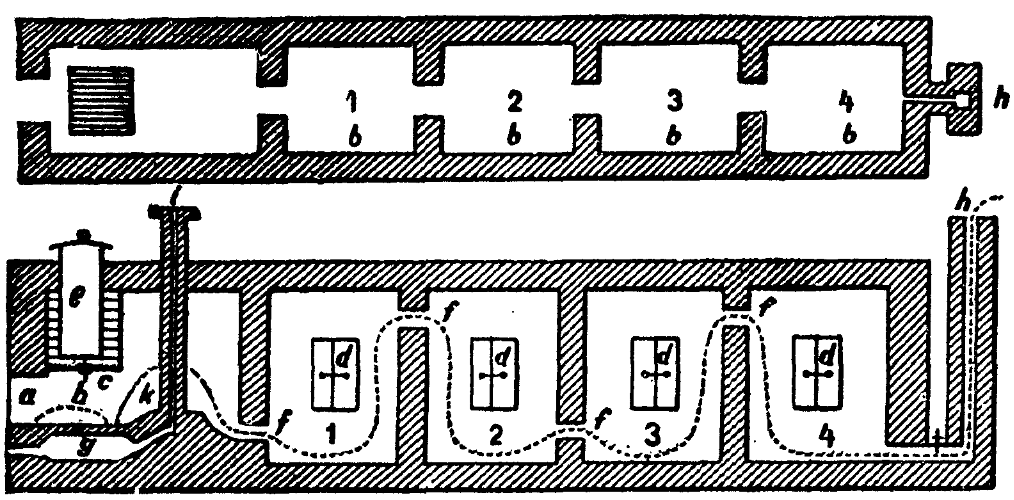

FIG. 5.

When the quantity of oil intended for decomposition has been used, the furnace is allowed to stand quietly for a few days, when the windows *d*, with which the chambers are provided, are opened. The finest quality of lamp-black is found in No. 4, a fine quality in No. 3, while Nos. 2 and 1 contain a coarser product; the two former qualities are sold as vegetable black, and the two latter as lamp-black.

In this country a large quantity of lamp-black is produced by the combustion of the natural gas which

flows out of the ground in many of the oil regions. It is sold under the names of gas-black or carbon-black. The principle on which its manufacture is based is the cooling of the flames of the burning gas by iron plates. At first stationary plates with long trough-shaped upper surfaces were adopted, and were kept cool by means of a current of water. These plates being found subject to certain defects, they have now been replaced by revolving plates or cylinders, which, during the time the black is being deposited, automatically revolve, and thus the black as it is formed is removed from the action of the flames and cannot be overburnt, as was frequently the case with the old style of plates. As the plates or cylinders revolve they come into contact with fixed scrapers, which remove the black from the surface as fast as it is formed. Carbon-black differs from oil lamp-blacks in being granular in form and rather denser. It is blacker in hue than any of the other black pigments. For grinding this product, steel mills are preferable to stone mills. It is the purest form of carbon-black made, quite free from any trace of unburnt oil often present in lamp-blacks, and from any trace of mineral matter.

Lamp-black is in the form of a black flocculent powder with a fine texture. In hue it is usually jet-black, although some samples have a faint brownish tinge. It has great coloring and covering powers. It is rather difficult to mix with various vehicles, especially with water, but, when mixed, it works well as a paint. It dries rather badly when used as an oil paint, especially when it contains unburnt oil. It consists almost entirely of carbon, but there is a small quantity of moisture and mineral matter present in all samples.

Ivory black and bone black. These pigments are

ivory and bone charred to blackness by strong heats in closed vessels. They vary very much, chiefly through want of skill and care in preparing them. When well made they are fine neutral blacks, perfectly durable and eligible for oil and water painting; but when insufficiently burned they are opaque and faint in color.

Ivory black or bone black is made by exposing fragments and turnings of ivory and similar osseous parts of animals, to heat in close vessels until they are reduced to charcoal. When cool the hard carbonaceous residue is pounded and ground with water, washed in a filter with water, and dried.

Frankfort black is made from a great variety of materials of an organic character, such as vine twigs, refuse of wine-making, peach stones, cork cuttings, bone shavings, etc. The materials are calcined in a close vessel until they are thoroughly charred. The black so obtained is then ground up as fine as possible with a little water. The mass is then lixiviated to free it from soluble matters and dried. It is then mixed with a little glue water and made up into pear-shaped drops, which are dried and are then ready for sale. Frankfort black is also known as *drop black*. It is a black of fine texture, varying in hue from a bluish-black to a somewhat reddish-black, which is due to the different materials of which it is made; vegetable matters yielding a black of a bluish hue, and animal matters one of a grayish tint.

Besides the black pigments described above, there are several other substances known as Prussian black, black lake, tannin black, etc., which have been proposed as black pigments, but their use is so limited that it is not necessary to give a description of them.

LAKES.

The name given to this series of red and other colored pigments is derived from the lac and lacca of India. They may be defined to be compounds of an organic coloring principle with a metallic body. The organic coloring principle may be obtained from natural coloring matters, such as lac, cochineal, Persian berries, fustic, Brazil wood, etc., and it may be derived from the coal-tar colors, a source which only lately has come into prominence for lake making, but which promises to supplant the natural coloring matters for this purpose, as they have done for dyeing textile fabrics.

The coloring principle of most natural coloring matters is of an acid or phenolic character, and will combine with bases such as tin, aluminium, iron, lead, antimony, etc., to form colored bodies which are insoluble in water. As a rule, the affinity between the two bodies is so great that the lake is precipitated when a solution of a metallic salt is added to one of the coloring matters. Theoretically, a lake should be a compound of the coloring principle and the metallic base in equivalent proportions, but practically such a lake does not exist, the base, as a rule, largely predominating.

Lakes are usually made by preparing a decoction of the coloring matter and then adding to this a solution of the base, the lake, as a rule, forming almost at once. Sometimes the addition of a small quantity of a solution of carbonate of soda is sufficient to throw down the lake.

All lakes should be quite insoluble in any vehicle, such as water, oil, turpentine or spirit, used to make them into a paint. On the other hand, a true lake is always more or less transparent when used as a pig-

ment, and lakes are, therefore, mostly used as covering or glazing colors to modify the tint of an under-coat of paint, and to obtain effects which are not possible with opaque pigments. Some lakes are rendered nearly opaque by mixing the materials during the process of manufacture with some opaque white pigment by which the body or covering power of the lake is increased, and at the same time the shade is more or less affected. If a lake dissolves in the vehicle, then all its properties as a pigment in regard to its body or covering power are lost, and a colored varnish only is obtained, which will not do the work it is intended that the lake-paint should do.

Carmine is a combination of the coloring principle of cochineal with alumina and tin, and forms almost a pure lake. The statements regarding the preparation of carmine differ; the exact method of its preparation having never been published, and is probably only known to a few makers of this lake. According to one statement, cochineal is extracted by boiling in water, the decoction strained off, alum added to it, and the boiling is continued for a few minutes longer. The clear liquor is decanted off, cream of tartar added, and the mass allowed to stand for the carmine to settle.

Another method is as follows: Boil 4 lbs. of cochineal in water, strain off the decoction, add 4 ounces of alum, 6 ounces of muriate of tin, 4 ounces of carbonate of soda, and allow to stand for two days, when the carmine will have been precipitated.

Carmine is a deep fiery-scarlet powder, slightly varying in tint. The best quality is known in commerce as "nacarat carmine." It is insoluble in water, alcohol, ether, turpentine, and all the vehicles used in mixing paints, but is soluble in strong mineral acids.

Carmine lake. In preparing carmine the whole of the coloring matter of the cochineal is not precipitated, and, therefore, the liquors from the carmine are strongly colored and are utilized for the preparation of carmine lake. A small quantity of alum and of tin chloride is added to the liquor, and then sufficient solution of carbonate of potash to precipitate the whole of the alum and tin. The precipitate is collected, washed and dried.

Another method is as follows: Boil 1 lb. coarsely powdered cochineal in 2 gallons of water for two hours. Decant, and strain the decoction, add the solution of 1 lb. of cream of tartar, and precipitate with solution of alum. By adding the alum first and precipitating the lake with the cream of tartar, the color is slightly changed.

Brazil wood lake. Digest 2 lbs. of ground Brazil wood in 8 gallons of water for 24 hours, boil one-half hour, and add 3 lbs. of alum dissolved in as small a quantity of water as possible. Mix, decant and strain. Then add 1 lb. of tin solution, again mix well and filter. To the clear liquid cautiously add a solution of soda carbonate while a precipitate forms. The precipitate is collected, washed and dried.

Madder lake. Tie 4 ounces of madder in a cloth, beat it well in 1 quart of water in a stone mortar, and repeat the process with about 5 quarts of fresh water until the madder ceases to yield color. Boil the mixed liquors in an earthen vessel, pour them into a large basin and add 2 ounces of alum dissolved in 1 quart of boiling water. Stir well and gradually pour in 3 ozs. of a strong solution of carbonate of potash. Let stand until cold, pour off the supernatant yellow liquor, drain, agitate the residue repeatedly in 2 quarts of boiling water, decant, drain and dry.

Or: Macerate 2 lbs. of ground madder in 1 gallon of water for 10 minutes; strain and press quite dry. Repeat the operation twice or three times, and add to the mixed liquors ½ lb. of alum dissolved in three quarts of water. Heat in a water bath for 3 to 4 hours, constantly replacing the water lost by evaporation. Filter first through flannel and when cold enough through paper. Add solution of carbonate of soda as long as a precipitate falls. Wash the latter till the water runs off colorless, and then dry.

Yellow lakes. I. Boil 1 lb. of Persian berries, quercitron bark, or turmeric, and 1 oz. of cream of tartar in 1 gallon of water until reduced to half the volume. Strain the decoction and precipitate by solution of alum.

II. Boil 1 lb. of the above mentioned dye-stuffs with ½ lb. of alum in water. Strain the liquor and add sufficient carbonate of potash to precipitate the lake. Care must be taken to avoid an excess of the alkali, as this would redissolve the coloring matter.

Orange carmine or orange lake. Boil 2 lbs. of Persian berries in 2 gallons of water and strain the liquor. Then add ½ lb. of muriate of tin (commercial stannous chloride solution) and sufficient sodium carbonate to precipitate the lake. The latter is collected, washed and dried.

Or: Best Spanish annatto 4 ozs., pearl ash ¾ lb., water 1 gallon. Boil all for one-half hour, strain, precipitate with alum 1 lb., dissolved in water 1 gallon. Do not add any more of the alum solution when it ceases to produce effervescence or a precipitate. The addition of a small quantity of solution of tin turns this lake a lemon yellow.

Violet lake may be made by adding 2½ gallons of an-

timony chloride of 52° Tw. to each 16 gallons of a decoction of logwood of 10° Tw. The lake is immediately precipitated, and is filtered, washed and dried.

Aniline lakes. In the preparation of these lakes three things are chiefly required—1, the coloring matter; 2, the base, *i. e.*, a substance which gives covering power to the coloring matter, and 3, the precipitating agent.

As coloring matter the basic and acid aniline colors may be used, the adjective coloring matters being more difficult to handle. As the base, barytes, gypsum, kaolin and zinc oxide may be employed, each of these substances, when used by itself, possessing certain advantages and disadvantages. A mixture of barytes, gypsum and kaolin, however, answers very well for most aniline colors. Tannic acid, picric acid, acetate of lead, barium chloride and alumina sulphate serve as precipitating agents.

The following colors are precipitated by tannic acid: Fuchsin, aniline blue, brilliant green, methyl green, Nile blue, rhodamine, safranin, phosphin, chrysoidin, Bismarck brown, methyl violet, chinoline yellow, and auramin. The use of tartar emetic in connection with tannic acid is of advantage, the shades of color becoming thereby deeper and the lakes less soluble than when precipitated with tannic acid alone.

The colors which are precipitated by picric acid are: Auramin, methyl blue and brilliant green.

Colors precipitated by acetate of lead: Scarlet BB, orange G, fast scarlet, scarlet 3R, yellow N, crocein orange, fast red T, alkaline blue, citronin, scarlet G and R, ponceau 2G, fast violet, orchil brown B, fast red, azo-yellow, double brilliant scarlet 2R, Indian yellow, crocein 3B, chinoline yellow, crystal scarlet

6R, phosphine, scarlet OO, scarlet GT, Bordeaux S, and all the eosin colors.

Colors precipitated by alumina sulphate: Scarlet BB, orange II, orange IV, fast scarlet 3R, crocein-orange, alkaline blue, Victoria blue B, citronin O, scarlet G, fast violet, orchil brown B, azo-yellow, Indian yellow, and scarlet GT.

Colors precipitated by barium chloride: Scarlet BB, ponceau, orange G, orange IV, fast scarlet 3R, yellow N, crocein-orange, crocein, fast red T, alkaline blue, Victoria blue B, citronin O and A, scarlet G, ponceau 2R, resorcin-yellow, fast violet, orchil brown B, fast red A, double brilliant scarlet, chinoline-yellow, naphthol-yellow S, phosphin, scarlet 2R, GT, 2RT, and 3R.

Colors precipitated by tannic acid and picric acid can only be used as water colors, they drying with great difficulty when employed as oil-paints. Colors prepared with the assistance of acetate of lead, alumina sulphate and barium chloride can be used as water colors and oil-paints.

The preparation of aniline lakes is quite a simple process. The base, barytes, china clay, or whatever is used, is thoroughly mixed or diffused through the requisite quantity of water, care being taken to break up all lumps, because these would give the lake a speckled appearance. The coloring matter previously dissolved in water is then added and the whole heated to from 120° to 150° F. The precipitating agent, in the form of solution, is then run in slowly with constant agitation. When all has been run in, the lake is allowed to settle and the supernatant liquor drawn off. The latter should be colorless or nearly so. If it be strongly colored, the precipitation of coloring matter has not been complete, and more precipitant is added.

The lake is now washed by adding clean water. When required for pulp-colors, the lake is simply filtered off, but if required dry, it is dried at as low a temperature as possible, to prevent its color or tint being affected.

The proportions of the various substances used may be seen from the following examples:

Fuchsin lake. Barytes or another base 200 parts by weight, magenta 2, tartar emetic 3, tannic acid 6.

Green lake. Barytes or another base 200 parts by weight, brilliant green 2, auramin 1, tartar emetic 2, tannic acid 6.

The tartar emetic mixed with coloring matter is added to the base, and then the tannic acid solution.

Scarlet lake. Barytes or another base 100 parts by weight, fast scarlet 3, acetate of lead 10.

Green lake. Barytes or another base 100 parts by weight, crystal green 1, picric acid 1.

Yellow lake. Barytes or another base 100 parts by weight, Indian yellow 3, barium chloride 5.

By using mixtures of the coloring matters in various proportions, a great variety of lakes of different colors can be prepared.

Vermillionettes and royal reds. These lakes have recently been introduced in practice. They are made in a great variety of tints, from a very pale pinkish red to a very deep scarlet. Vermillionettes are now made from barytes and eosine, with a precipitating agent, although when first introduced they contained orange lead as well, and some makers mix them so now. Royal reds contain both barytes and orange lead, as well as the eosine. The precipitating agent most used is acetate of lead.

The following receipts for preparing several shades

of these pigments exemplify the quantities of the materials used:

Vermillionettes.

	No. I, Pale. Parts by weight.	No. II, Deep. Parts by weight.	No. III, Deep. Parts by weight.
Barytes . . .	100	100	100
Orange lead.	30	30	—
Eosine . . .	2	6	8
Lead acetate.	6	16	20

Royal Reds.

	No. I, Pale. Parts by Weight.	No. II. Deep. Parts by Weight.
Orange lead.	100	100
Eosine	4	8
Lead acetate	10	20

Vermillionettes and royal reds are very brilliant in hue and have a good depth of color, whether used as oil-paints or water colors. They do not resist lengthened exposure to light and air, and, therefore, cannot be recommended for work which must have permanence. However, when protected by a coat of varnish they will stand a good deal of exposure.

GRINDING AND WASHING COLOURS.

THE following directions for the grinding of colours will be found of use to those who may not find it convenient to have a mill for the purpose, such as that we have described in a former part of our work.

In grinding, place yourself in such a situation, with respect to the grinding-stone, that you may be able with ease to exercise the full length and strength of your arms in the use of the muller. Then place upon the stone a *small quantity* of the colour you are about to grind, not above two-thirds of a common saucer full at most. Novices are apt to entertain an idea that the work would be hastened by grinding a great deal at once, but this is a mistake. The less you grind at a time the easier will be the process and the finer the colour. One of the most essential points in the preparation of a colour is its being reduced into as small parts as possible. The beauty of its appearance and the profit arising from it equally depend upon this: and a good workman will not therefore grudge the time employed in the operation. When you have laid your colour on the stone, pour upon it a little of the oil or varnish with which you intend to grind it, being careful not to put too much at first

Mix the oil and the colour together; then place the muller upon them, and turn it a few times about. If you find there is not oil enough, add a little more, and continue to grind till the colour becomes of the consistence of an ointment. Be careful not to add too much oil, so as to make the colour too thin and cause it to run about the stone; for then it will be necessary to add more solid matter, which would occasion a great waste of time and labour. When the colour is rendered thinner than it should be, the grinding is less fatiguing, but it occupies more time; when thicker, the work is more laborious, but more speedily executed. Experience will teach you to judge correctly in this matter.

Should the colour spread during the grinding, you must bring it together with your palette-knife or voider. When you have ground it sufficiently fine, which you may determine by the difficulty of raising the muller from the stone, and by the noise occasioned by the grinding at first almost entirely subsiding, take up the muller: then if you find the colour completely smooth like butter, without any grittiness, take it off the stone with a palette-knife or spatula, and put it into your pot or pan. Afterwards lay more colour upon the stone, and continue grinding in the same manner till the necessary quantity is ground.

It is always desirable to grind at one time as much of a colour as is required for the work you have in hand: if you prepare it at intervals, in different quantities, you will often find some difficulty in procuring exactly the same shade or tint; and if you fail in this, the appear-

ance of the work will be sadly disfigured. Should any colour happen to be left which you are desirous of preserving, you have only to cover it with water and deposit it in a cool place. It is likewise advisable to take the same precaution with your colours, if you have occasion to rest for a time, as it will prevent their drying, even in the hottest weather.

It is not unusual with painters and varnishers, who have much business, to grind or prepare at once quantities of different colours or varnishes sufficient to serve them for a long while. These, as the best mode of preserving them, they keep tied up close in ox or sheep bladders, so as to be always ready when wanted.

Colours that are of a coarse and sandy nature can seldom be ground to a proper degree of fineness. Where common work only is required, this is not very material; but in cases where superior delicacy is necessary, such colours, after being ground, must undergo the operation of washing.

The chief of these are yellow ochre, charcoal, bone-black, Spanish brown, red lead, white chalk, verditer, and Saxon blue.

In washing colours, put the quantity you wish to clean into a vessel of clear water, and stir it till the water becomes coloured; skim off any filth you observe swimming at the top; and when you think the grossest part of the colour is settled at the bottom, pour off the water into a second vessel, large enough to hold four or five times as much water as the first; then pour some more water into the first vessel, and proceed as before. Keep

repeating this till you find all the fine part of the colour drawn off, and none but the gritty particles remaining in the bottom of the first vessel. Let the water in the larger vessel stand till it be quite clear and all the colour settled at the bottom; then pour the water off from it, and the colour at the bottom, *when completely dried*, will be fit for use.

Colours, whether you grind them yourself, as above directed, or purchase them ready ground, will, in that state, be too thick for use, and it will be necessary to dilute them with the varnish or oil you propose to employ, in order to bring them to a proper consistence. In doing this, extremes must be carefully avoided. If the colour be made too thin, it runs, and does not cover the article to be painted equally or exactly; if too thick, it forms lumps, is hard to spread, occasions more expense, disfigures the work, and fatigues the hand which applies it. If, when the brush is taken from the pot and turned two or three times round in the hand, being held obliquely, so as to check the thread which is formed, the colour do not drop from it, it will then be as stiff as it can be well wrought with; and this is the proper state for use, as both expedition and durability are gained by it. If it be thin enough to allow the ground on which it is laid to be at all seen through it, it cannot be good; and though it may work more easily at the time, it will require repeated coatings to make it perfect and substantial, when one of a proper thickness would have been sufficient. I may here remark, that many jobs being contracted for by painters at so much a yard, and the

work to be coloured *three times over*, some are in the habit, with a view of sparing paint and labour, of making their colourings so thin as not to be altogether equal to one good coating. But this is a practice which no tradesman, who values his own character or that of the work turned out of his hands. will adopt.

COMPOUND COLOURS, OILS, AND VARNISHES.

THE various colours that may be obtained by the mixture of other colours, are innumerable. I only propose here to give the best and simplest modes of preparing those most frequently required.

Compound colours, formed by the union of only two colours, are called by painters *virgin tints.*

The smaller the number of colours of which any compound colour is composed, the purer and the richer it will be.

Light Gray is made by mixing white lead with lampblack, using more or less of each material, as you wish to obtain a lighter or a darker colour.

Buff is made from yellow ochre and white lead.

Silver, or Pearl Gray.—Mix white lead, indigo, and a very slight portion of black, regulating the quantities by the shade you wish to obtain.

Flaxen Gray is obtained by a mixture of white lead and Prussian blue, with a small quantity of lake.

Brick colour.—Yellow ochre and red lead, with a little white.

Oak-wood colour.—Three-fourths white lead, and one-fourth part umber and yellow ochre: the proportions of the last two ingredients being determined by the required tints.

Walnut-tree colour.—Two-thirds white lead, and one third red ochre, yellow ochre, and umber, mixed according to the shade sought. If veining is required, use different shades of the same mixture, and, for the deepest places, black.

Jonquil.—Yellow, pink, and white lead. This colour is only proper for distemper.

Lemon Yellow.—Realgar and orpiment. Some object to this mixture, on account of the poisonous nature of the ingredients. The same colour can be obtained by mixing yellow-pink with Naples yellow; but it is then only fit for distemper.

Orange colour.—Red lead and yellow ochre.

Violet colour.—Vermilion, or red lead, mixed with black or blue, and a small portion of white. Vermilion is far preferable to red lead, in mixing this colour.

Purple.—Dark-red mixed with violet-colour.

Carnation.—Lake and white.

Gold colour.—Massicot, or Naples yellow, with a small quantity of realgar, and a very little Spanish white.

Olive colour.—This may be obtained by various mixtures: black and a little blue, mixed with yellow; yellow-pink, with a little verdigris and lampblack; or ochre and a small quantity of white, will also produce a kind of olive colour. For distemper, indigo and yellow-pink mixed with white lead or Spanish white, must be used. If veined, it should be done with umber.

Lead colour.—Indigo and white.

Chestnut colour.—Red ochre and black, for a dark

chestnut. To make it lighter, employ a mixture of yellow ochre.

Light Timber colour.—Spruce ochre, white, and a little umber.

Flesh colour.—Lake, white lead, and a little vermilion.

Light Willow Green.—White mixed with verdigris.

Grass Green.—Yellow-pink mixed with verdigris.

An endless variety of greens can be obtained by the mixture of blue and yellow in different proportions, with the occasional addition of white lead.

Stone colour.—White, with a little spruce ochre.

Dark Lead colour.—Black and white, with a little indigo.

Fawn colour.—White lead, stone ochre, and a little vermilion.

Chocolate colour.—Lampblack and Spanish brown. On account of the fatness of the lampblack, mix some litharge and red lead.

Portland Stone colour.—Umber, yellow ochre, and white lead.

The variety of shades of brown that may be obtained, are nearly as numerous as those of green.

To imitate Mahogany.—Let the first coat of painting be white lead, the second orange, and the last burned umber or sienna; imitating the veins according to your taste and practice.

To imitate Wainscot.—Let the first coat be white, the second half white and half yellow ochre, and the third yellow ochre only. Shadow with umber or sienna.

To imitate Satin Wood.—Take white for your first

coating, light blue for the second, and dark blue or dark green for the third.

OILS.

We come, next, to speak of the principal oils which are used in the preparation both of colours and varnishes.

Oil of Spike was formerly much more in use than it is at present. It is a volatile oil, and has the advantage of drying more speedily than any of the fat oils; it is also free from any offensive odour. It is, however, generally in a very impure state; and of this painters are so thoroughly convinced, that they have pretty generally renounced it. In all preparations for varnishes, where it is directed to be employed, oil of turpentine, which is much cheaper, can be substituted without any other inconvenience than what may arise from its stronger smell.

Oil of Lavender is principally used by enamellers, to whom it is particularly valuable, from its consistency being such as to prevent the colours that are mixed with it from running. Its property of drying more equally and gradually than perhaps any other oil, renders it also of service to the varnisher.

Oil of Poppies has one advantage possessed by no other—that of being perfectly colourless For this reason, a decided preference is given to it for delicate kinds of painting. Being, however, extremely fat, it is liable, unless very old, to the objection of being insufferably tedious in drying.

Nut Oil and *Linseed Oil,* both in very general use, rank among the fat oils. Their fatness, indeed, is so great, that it is mostly found necessary, before employing them in colouring, to give them a drying quality, which may be done in the following manner:—Take three parts of white vitriol, and twelve parts of litharge, and let them be reduced to as fine a powder as possible; then mix them with thirty-two parts of nut or linseed oil, and place the mixture over a fire just brisk enough to keep the oil slightly boiling. Let it continue to boil, till the oil entirely ceases to throw up any scum. Then take the vessel off the fire, and let it stand in a cool place for about three hours, and a sediment, which contains the fattening part of the oil, will be formed at the bottom. Pour off the oil which is above (being careful not to let any of the sediment mix with it) into wide-mouthed bottles. Let it remain a sufficient time to clear itself perfectly, before it is used, and you will find it possessed of the proper drying quality.

Sometimes, when the fire is not kept pretty equal while the boiling is going on, the colour of the oil is affected, so as to render it unfit for delicate painting. To avoid this, some persons tie up the litharge and vitriol, when powdered, in a bag; but, in this case, the quantity of litharge must be doubled. The bag must also be suspended by a piece of packthread to a stick made to rest upon the edges of the vessel, so as to keep the bag at the distance of an inch from the bottom. This method, too, is slower than that of boiling the drying material along with the oil.

In some kinds of work, such as the preparation of floor-cloths, and painting large figures or ornaments, in which clayey colours are employed, an extraordinary rapidity in drying is sometimes necessary, which could not be procured by using the proportions of drying materials above mentioned. In such cases, it is customary to increase the quantity of litharge in any proportion that may be requisite. On some occasions, the litharge employed has amounted to one-fourth part of the whole quantity of oil.

The process used for giving a drying quality to nut and linseed oil will not do for oil of poppies, which would thereby be deprived of its colourless property, the most valuable one which it possesses.

Many painters consider it a matter of indifference whether nut or linseed oil be employed in colouring, and therefore, for the sake of cheapness, give the preference to the latter. But they labour under a mistake; for these two oils should, by no means, be used indiscriminately. In painting which is allowed to be coarse, or which is sheltered from the effects of the rain and sun, linseed oil will answer the purpose. But where any nicety is required in colouring, in situations exposed to the weather, nut oil only is proper, as it nourishes and develops the colour; whereas linseed oil dissipates and destroys it, and obliges the work to be done afresh in a short time. In painting exposed to weather, persons aware of the impropriety of using linseed oil, are sometimes induced to mix a portion of oil of turpentine with nut oil, to save cost; but this mixture has almost as injurious an effect

in whitening colour which is exposed to the sun, as pure linseed oil.

I have before said that linseed oil will serve for painting that is not exposed to the rain and sun. This is not, however, the case when a pure white is wanted, for linseed oil has the effect of turning the white lead yellow, and nut oil should therefore be employed. If that is considered too expensive, one part of turpentine, at least, ought to be mixed with two parts of linseed oil.

Oil of Turpentine is more used than any of the preceding oils; the varnisher, indeed, scarcely employs any other. There is a great difference in the quality. The inferior kinds, though they may serve for mixing coarse and common colours, can never be used with good effect in varnish. The best description is that which is the lightest and least coloured. A simple method of trying its degree of goodness is with the best spirits of wine, which will take up about one-third part of the weight of the inferior sort of oil, and only about a seventh or eighth part of the best kinds.

Fat oils are often mixed with the oil of turpentine, as well as with other volatile oils—a mixture particularly hurtful in the case of varnishes. There is a remarkable distinction, however, between the two, by which such adulterations may be always readily detected. Both sorts of oil stain paper,—but a stain from a volatile oil may be easily removed by heat, while one from fixed oils remains almost indelible. Thus, if a drop of common oil be thrown on paper, and held near a fire, a part flies off; but, before the whole of it can be dissipated, the

paper is destroyed. If, on the contrary, a few drops of turpentine (or any other volatile oil) be thrown on paper and treated in the same way, the stain disappears without the texture of the paper being in the smallest degree injured. And if paper be stained with an oil compounded partly of a volatile and partly of a fat oil, that portion only which is volatile will evaporate on exposure to heat, while the other will remain.

It is owing to the property just mentioned, that volatile oils are sometimes employed to make transparent paper for copying drawings.

For this purpose, the paper is besmeared with pure volatile oil of turpentine, and dried for a short time, by exposure to air; it is then put on the drawing, the traces of which are distinctly seen through it. After taking off the copy by a pencil, the oil is easily expelled by holding the paper near the fire.

Drying Oils, which are composed of particular substances mixed with some of the oils before mentioned, are useful for several purposes. They are most valuable when so manufactured as to be colourless. They are much used in preparing varnishes; and, in oil painting, are not unfrequently employed as a varnish, either alone or diluted with a little oil of turpentine. Drying oil is easily procured at the shops; but, if you wish to make it yourself, one of the best methods is to take a pound of nut or linseed oil, (according as it is intended for inside or outside work,) to which a drying quality has been given by the method before mentioned; dissolve in it five ounces of rosin by means of a gentle heat; when

this is done, add to it rather more than half an ounce of turpentine: let the composition rest till a sediment is formed and is quite cool; then pour it, free from any part of the sediment, into proper vessels, and make use of it while fresh. If at any time it should become too thick, you may dilute it with a little oil of turpentine.

Some painters of ornaments, and coach painters, instead of using drying oils, content themselves with adding white vitriol in mixing their colours. This method is bad; the salt of the vitriol will not unite with the oil, and the painting, in consequence, becomes mealy, and sometimes cracks.

When drying oil is colourless, it is of great use to painters of pictures, by whom, as well as by the house painter, it is not unfrequently used as varnish, either in a pure or dilute state.

It has been recently discovered, that when a solution of yellow soap is added to red, yellow, and black paints, when ground in oil, before they are casked up, they acquire no improper hardness, and dry remarkably fast when laid on with the brush, without having recourse to any of the usual drying expedients.

Pilchard Oil, which possesses more greasy matter than any other fish oil, has been used in Cornwall for the last fifty years, to great advantage, in coarse painting. The preparation is said, by a correspondent in the *Mechanics' Magazine*, (vol. vi., page 471,) to be made in the following manner: Put the oil into a clean iron pot, and place it over a slow fire, (wood is best,) to prevent it from burning; when it begins to heat, skim it well; let

it remain on the fire till it singes a feather put therein. For every gallon of oil, add a small table-spoonful of red litharge. Stir them together well for about three minutes; then take the pot off the fire, and let the mixture cool in the open air, after which it is fit for use. It is said to dry quickly, to incorporate well with any coloured paint on wood or iron, to have all the appearance of varnish, and to be extremely durable.

VARNISHES.

Strictly speaking, every substance, whether dry or liquid, is a varnish, which, being spread over any body, has the effect of giving its surface a brilliant appearance. But, in its general meaning, the term is only applied to those substances that are capable of rendering this effect *durable*.

The foundation of all varnishes are gummy and resinous substances; and the only liquids that can be combined with them, so as to form varnishes, are oils and spirit of wine.

For a varnish to be really good, it ought to be limpid, brilliant, transparent, and durable. The durability of a varnish is its greatest and rarest excellence.

The principal gums and resins used for varnishes are gum Arabic, gum elastic, gum anima, copal, dragon's blood, stick-lac, shell-lac, and mastic. The solvents chiefly employed are spirits of wine and spirits of turpentine.

In choosing gums and resins, those are to be preferred

which are quite free from particles of dirt, and of which the lumps, when held up to the light, present a clear and transparent appearance.

What is often sold at the shops as gum Arabic—the best of all the gums—is frequently only the clearer pieces of the gum Senegal, which, though equally strong and substantial, is far from being so pure as gum Arabic. The imposition may be detected by observing one very obvious distinction. The genuine gum Arabic is always in *small* irregular masses, *smooth on the outside;* the pieces of the gum Senegal are invariably larger, and *rough* on the outside.

A composition of different resins, coloured with brick-dust or Brazil-wood, or a very small portion of real dragon's blood, is not unfrequently sold as genuine. It is of a dull red or brick colour, whereas real dragon's blood is ~~a dark~~ red, and almost brown colour on the outside. The latter, too, is inflammable; while the imitation, when put into the fire, does not inflame, but swells up.

The liquid commonly sold under the name of *spirits of wine* is in general a highly-rectified spirit, intermediate between proof spirit and alcohol, but not sufficiently concentrated for the purpose of making varnish. The readiest practicable method of determining whether the alcohol will answer your purpose, is to fill a large phial with it, and then to drop into it a small lump of potash or pearlash, which has been heated very hot over the fire, to expel its moisture, and not afterwards suffered to become cold: the phial is then to be well shaken, and if the lump remain dry, or nearly so, the

alcohol is good; if any considerable portion of it remain undissolved, it is unfit for use.

Spirits of turpentine are always good in proportion to their inflammability—that which burns most readily being the best. The smell, too, of the inferior kind is more unpleasant and less powerful than that of the better sort.

When doubts are entertained as to its purity, pour about two table-spoonfuls into a saucer, and place it to evaporate in the sun, which it ought to do entirely in the course of two or three hours; if a greasy residuum or a soft, sticky mucus is left, it is a proof that the turpentine is adulterated, and ought to be rejected.

Another method of judging of the comparative goodness of different sorts both of spirits of wine and spirits of turpentine, is by weighing quantities of two kinds, equal in measure, one against the other: *the lightest is always the best.*

The number of different varnishes to be obtained by various methods of mixing together the substances from which they can be manufactured, is endless, and it would be altogether from the purpose and nature of this little work to attempt any thing like a description of them. Many of them, indeed, are only useful to the artist, and are therefore not entitled to a place here; while others are merely proofs of the ingenuity of chemical students, and, from the expense or sacrifice of time attending their preparation, are not adapted for practical purposes. Almost every varnisher, too, has at least one or two compositions peculiar to himself, the superior value of which

rests chiefly in his own opinion. In large towns and cities, moreover, the varnishes in common use can easily be purchased ready made; but for the benefit of those who may not have this convenience, or who prefer preparing their own varnishes, I shall here add a few simple recipes, from modern and approved sources, for making those that are in the most general use.

Shell-lac Varnish.

The best of the common spirit varnishes is that made with *shell-lac*. Hitherto the use of it has been limited, in consequence of its possessing a brown-yellowish colour, which made it unfit for all articles which that tint would injure; but Professor Hare, of Philadelphia, has made the arts a valuable present of the following method of producing it perfectly colourless: Dissolve, in an iron kettle, one part of pearlash in about eight parts of water; add one part of shell-lac, and heat the whole to ebullition. When the lac is dissolved, cool the solution, and impregnate it with chlorine till the lac is all precipitated. The precipitate is white, but its colour deepens by washing and consolidation; dissolved in alcohol, lac bleached by the above process yields a varnish which is as free from colour as any copal varnish. *Chlorine* (oxy-muriatic acid) may be formed by mixing intimately eight parts of common salt and three of the black oxide of manganese in powder: put this mixture into a retort; then pour four parts of sulphuric acid, diluted with an equal weight of water and afterwards allowed to cool, upon

the salt and manganese; the gas will then be immediately liberated, and the operation may be quickened by a moderate heat. A tube leading from the mouth of the retort must be passed into the resinous solution, when the gas will be absorbed, and the lac precipitated.

It is to be presumed that, now that shell-lac varnish is thus rendered universally applicable, it will be the most used of any; as it possesses all the properties of a good spirit varnish in a higher degree than any of the other resins, and costs at the same time much less.

Shell-lac Varnish of various colours may be made by using any colour in fine powder with the varnish, in the following manner: Rub up the colour with a little alcohol, or spirits of turpentine, till it becomes perfectly smooth; then put it into the cup with the varnish.

Red Shell-lac Varnish

Is best made from good Dutch sealing-wax (which is itself chiefly composed of seed lac). This is the lac used to varnish glass or wood for electrical purposes. Three or four coats will make a perfect covering.

Turpentine Varnish.

Take five pounds of clear good rosin, pound it well and put it into a gallon of oil of turpentine; boil the mixture over a stove, till the rosin is perfectly dissolved; and when cool, it will be fit for use.

Linseed Oil Varnish.

Boil any quantity of linseed oil for an hour, and to every pound of oil add four ounces of good clear rosin, well powdered; keep stirring it till the rosin is perfectly dissolved, and when this is done, add one ounce of spirits of turpentine for every pound of oil, and when strained and cool, it will be fit for use.

This varnish is much used for common purposes. It is cheap, is a good preservative of wood, and not liable to sustain injury from the application of hot water.

Copal Varnish.

Take one ounce of copal and half an ounce of shell-lac; powder them well, and put them into a bottle or jar containing a quart of spirits of wine. Place the mixture in a warm place, and shake it occasionally, till you perceive that the gums are completely dissolved; and when strained, the varnish will be fit for use.

I have given the above as the simplest, and therefore the most usual method of making common copal varnish; but it may be prepared in a variety of ways, where particular uses may be required.

Gold-coloured Copal Varnish.

Take one ounce of powdered copal, two ounces of essential oil of lavender, and six ounces of essence of turpentine. Put the oil of lavender into a matras of a

proper size, placed on a sand-bath subjected to a moderate heat. When the oil is very warm, add the copal from time to time, in very small quantities, and stir the mixture with a stick of white wood, rounded at the end. When the copal has entirely disappeared, put in the turpentine in almost a boiling state, at three different times, and keep continually stirring the mixture till the solution is quite completed.

When this varnish is required to be colourless, as is frequently the case, it will be necessary to use the rectified spirit of turpentine—the common essence sold at the shops being generally high-coloured

Camphorated Copal Varnish.

Take copal in powder, four ounces; essential oil of lavender, twelve ounces; camphor, a quarter of an ounce, and as much spirit of turpentine as will give the varnish the consistency required. Heat the oil and the camphor in a small matras, stirring them, and putting in the copal and turpentine in the manner directed in the preceding varnish.

This varnish is particularly well adapted for articles which require transparency and pliability, united to great durability, such as the varnished wire-gauze used in ships instead of glass.

Copal Varnish in Imitation of Tortoise-Shell.

Take of amber-coloured copal, six ounces; of shell-lac or Venice turpentine, an ounce and a half; twenty-four

ounces of clear linseed oil, and six ounces of essence of turpentine. Place the copal in a matras, and expose it to a moderate heat till it is liquefied; then add the linseed oil in a boiling state, afterwards the shell-lac or Venice turpentine, also liquefied, and lastly the spirit of turpentine in small portions. If the varnish prove too thick, dilute it with spirit of turpentine.

This varnish is principally used for watch-cases, though it is also applied to other imitations of tortoise-shell.

All the above methods, however, of preparing copal require long boiling and careful filtering in the preparation, and consequently are not so convenient as the process first mentioned: they are therefore seldom used, unless where the nature of the substance to be varnished renders oil of turpentine decidedly preferable to spirits of wine.

An excellent copal varnish may be made by putting an ounce of copal of an amber colour, finely powdered, into a flask containing four ounces of ether; corking the mixture with a glass stopper, and shaking it for half an hour; then allowing it to rest till the liquor becomes perfectly clear.

It is unfortunate that the great volatility of ether and its very high price do not allow the use of this varnish for common purposes. Indeed, its employment is almost confined to repairing accidents in enamel, and restoring the smooth surface of paintings that have been cracked or shattered. It has some admirable properties, which belong to no other varnish in existence. It presents

great resistance to the friction of hard bodies, possesses remarkable solidity, has a peculiar drying quality, and a very fragrant smell.

Copal, and other varnishes, prepared with essence of turpentine, will not admit of being applied to purely white grounds, unless the turpentine has been highly rectified; and even then it is not unattended with risk. For coloured grounds, which require solidity, they are excellent.

The varnishes prepared with copal are some of the most useful and valuable known, and their composition has been much improved of late years. They are rich, splendid, and solid, bear friction well, and are of great service in preserving articles exposed to damp or rain. Mathematical and philosophical instruments are generally varnished with them.

Amber Varnish.

Put eight ounces of amber, finely powdered, into a vessel containing half a pint of the best spirits of turpentine; (if for very fine purposes, rectified spirits of turpentine should be used;) place the vessel over a stove or fire till the amber is quite melted; then put it into two ounces of shell-lac powdered, and place it on the fire again; keep stirring it till the gum is completely dissolved, and then add to the whole an ounce of clear cold-drawn linseed oil. Stir it well together, and when strained, it will be fit for use.

Like copal varnish, this varnish may likewise be pre-

pared in various ways; but the one here given is the cheapest and readiest, and the other methods of making it do not in any case possess advantages over this. Some varnishers prefer using more spirits of turpentine and a smaller proportion of linseed oil.

Some years since, amber varnish was in very general use; but of late, copal, on account of its being less coloured, has obtained a preference.

Caoutchouc, or Gum-elastic Varnish.

Take eight ounces of gum-elastic, pound it well, and put it upon the fire, in a vessel containing half a pound of boiling linseed oil. When the gum is dissolved, add half a pound of spirits of turpentine. Let them continue boiling together till the mixture becomes clear; and when it is cool, strain it for use.

This varnish is brilliant and durable; but it has the fault of drying very slowly, for which reason it is not employed.

Mastic Varnish.

This varnish, which is used principally for pictures in oil, is usually prepared by dissolving the mastic in spirits of turpentine, by means of a sand-bath, then straining it through a fine sieve, and afterwards placing it, for two or three weeks, in a bottle well corked, where the light of the sun may act freely upon it, which causes a large precipitation of mucilaginous matter, and leaves the varnish as clear as water. But to procure a mastic varnish

that can be perfectly depended upon, the following observations must be attended to: Let all the mastic be bruised by a muller on a grinding-stone; this will separate the soft or oily tears, as they are called, and enable you to throw them aside: whereas, if the mastic is put in a mass into the turpentine, the tears remain imbodied with it, and prevent the varnish from drying hard, leaving a greasy or tacky surface. The next point of importance is to make use only of turpentine which has been twice distilled, or which is at all events quite clear and colourless: you must take care not to have it served to you through an oily measure, (as is too often the case,) but poured out of the carboy without being shaken or disturbed. When the mastic and turpentine are thus obtained perfectly pure, they may be dissolved in a clean bottle *without heat, and by half an hour's shaking in the hand.* Let them then be strained and treated in the usual way, as above mentioned.

A varnish similar to this is occasionally made, in which frankincense or sandrac is employed, instead of mastic, and is very well adapted for mixing up colours.

The French sometimes prepare this resin in pure alcohol; but mastic varnish thus prepared is liable to chill on the picture, and produces, in time, a kind of white scale over it, which injures its lustre.

Varnish for Violins, &c.

Take a gallon of rectified spirits of wine, twelve ounces of mastic, and a pint of turpentine varnish; put

them in all together in a tin can, and keep it in a very warm place, shaking it occasionally, till it is perfectly dissolved; then strain it, and it is fit for use. If you find it necessary, you may dilute it with turpentine varnish.

This varnish is also very useful for furniture of plum-tree, mahogany, or rosewood.

White hard Varnish.

Take one pound of mastic, four ounces of gum anima, and five pounds of gum sandrac: put them altogether, to dissolve, into a vessel containing two ounces of rectified spirits of wine, which should be kept in a warm place and frequently shaken till all the gums are quite dissolved; then strain the mixture through a lawn sieve, and it will be fit for use.

Varnishes for Paling and coarse Wood-work.

Grind any quantity of tar with as much Spanish brown as it will bear, without becoming too thick to be used as a paint or varnish; then spread it on the wood with a large brush. It soon hardens by keeping. The work should be kept as free from dust and insects as possible, till the varnish is thoroughly dry.

This varnish is an excellent preserver of the wood from damp; on which account, as well as its being cheaper, it is to be preferred to painting, not only for paling, but for weather-boarding, and all coarser kinds of painting on wood.

The colour may be made a grayish instead of a glossy brown, by mixing a small proportion of white lead, or of whiting and ivory black, with the Spanish brown.

Varnish for Coloured Drawings.

Mix together one ounce of Canada balsam and two ounces of spirits of turpentine. Before applying the composition, size the drawing or print with a solution of isinglass in water; when this is dry, apply the varnish with a camel's-hair brush.

The use of this varnish gives to coloured drawings and prints an appearance resembling that of oil paintings.

Varnish for Glass.

Reduce a quantity of gum tragacanth to powder, and let it dissolve for twenty-four hours in the white of eggs well beat up; then rub it gently on the glass with a brush.

Black Varnish for old Straw or Chip Hats.

Take half an ounce of the best black sealing-wax, pound it well, and put it into a four-ounce phial containing two ounces of rectified spirits of wine. Place it in a sand-bath, or near a moderate fire, till the wax is dissolved; then lay it on warm, with a fine soft hair brush, before a fire or in the sun. It gives a good stiffness to old straw hats, and a beautiful gloss equal to new. It likewise resists wet.

Varnish for Drawings and Card-work.

Boil some clean parchment-cuttings in water, in a glazed pipkin, till they produce a very clear size. Strain it, and keep it for use.

Changing Varnishes.

Varnishes of this description are called changing, because, when applied to metals, such as copper, brass, or hammered tin, they give them a more agreeable colour. Indeed, the common metals, when coated with them, acquire a lustre approaching to that of the precious metals; and hence these varnishes are much employed in manufacturing imitations of gold and silver.

It would be an endless task to enumerate all the various kinds of changing varnishes that can be made, and the methods of preparing them. One simple mode of mixing I shall, however, mention here, by which all the different tints that can be required for changing varnishes may be certainly obtained.

Put four ounces of the best gum gamboge into thirty-two ounces of spirits of turpentine; four ounces of dragon's blood into the same quantity of spirits of turpentine as the gamboge; and one ounce of anatto into eight ounces of the same spirits. The three mixtures should be made in different vessels.

They should then be kept for about a fortnight, in a warm place, and as much exposed to the sun as possible.

At the end of that time they will be fit for use; and you can procure any tints you wish by making a composition from them, with such proportions of each liquor as practice and the nature of the colour you are desirous of obtaining will point out.

Changing varnishes may likewise be employed, with very good effect, for furniture.—*See Lacquers.*

Mordant Varnishes.

These are a species of varnishes chiefly employed when a coating of some other substance is to be entirely or in part laid over them.

Compositions of this kind ought neither to be too thick nor too fluid, as either of these faults injures the delicacy of the gilding.

They should likewise be of rather a fat nature, because they must be so prepared as not to dry till the gilding is completed.

Various compositions are employed as mordants, and almost every workman has a favourite one of his own. One of the best is the following:—

Dissolve one ounce of mastic, one ounce of sandrac, half an ounce of gum gamboge, and a quarter of an ounce of turpentine, in six ounces of spirits of turpentine.

Another good mordant may be obtained by exposing boiled oil to a strong heat in a pan, and, when you perceive a black smoke disengaged from it, setting it on fire, and extinguishing it in a few moments by putting on the cover of the pan. Then pour the matter, while

it is warm, into a heated bottle, and add to it a little oil of turpentine.

Both the above mordants have something of a drying nature, and are therefore objectionable when the work to be done, after the application of the mordant, is of a kind that requires it to be a long time before drying. In such cases, the best mordant is formed by adding a little red lead to the copal varnish prepared with camphor and oil of lavender, as before directed.

The choice of mordants must in some measure be guided by the tone which you desire to give to your work, whether deep or light, red or yellow. For bronzing or very pale gilding, a mixture of asphaltum and drying oil, diluted with oil of turpentine, is much recommended.

One of the simplest mordants is that procured by dissolving a little honey in thick glue. It has the effect of greatly heightening the colour of the gold, and the leaf sticks to it extremely well.

GENERAL OBSERVATIONS ON VARNISHES.

It is a common practice, in the manufacture of spirit varnishes, to mix glass or sand with the gum or resin, for the purpose of enabling the alcohol to penetrate more readily into all parts of the mass. M. Ferrari, however, recommends (*Giornale de Fissica*, ix., p. 36) that in place of those substances, a coarsely-powdered charcoal should be used; for the glass or sand generally tends to

aggregate the gum or resin at the bottom of the vessels and to protect it from the solvent; whilst, on the contrary, the charcoal rather tends to raise and divide it. The most advantageous proportion appears to be one ounce of charcoal to one pound of the spirit or the oil of turpentine used. The uses to which different varnishes are to be applied must, of course, determine the choice of them. Good varnishes, prepared with spirits of wine, are very clear, brilliant, and delicate, and may be applied with success to furniture, and to fancy ornaments which are kept within doors, and admit of re-varnishing easily; but they have not body nor durability enough for coloured grounds—not even wainscoting, ceiling ornaments, &c., or any articles exposed to the weather. If you attempt to renovate them by rubbing, they become of a mealy appearance. Their inferiority to oil varnishes, is evident from the circumstance that oils will of themselves form varnishes by repeated application, whereas spirits of wine alone, so applied, disappear without leaving any trace.

Varnishes made with turpentine or other oils are much superior in many respects to those prepared with spirits of wine. They are pliable and smooth, as well as brilliant and durable. They yield better to the operation of polishing, and are less liable to crack.

Oil of poppies, nut oil, and linseed oil are used for making fat varnishes; oil of turpentine, and oil of lavender for the drier ones. The other oils are either too fat, too much coloured, or too dear to answer the purpose of the varnisher.

Oil of turpentine might be employed on all occasions instead of spirits of wine, in the composition of varnishes, were it not for the strong and disagreeable smell arising from it. The oil obtained from the coarse or common turpentine ought never to be used in the preparation of varnishes. A slight coating of spirits of wine varnish laid over one coat of turpentine, when dry, is of great use in removing the offensive odour.

Varnishes are usually kept in large strong glass bottles with a wide mouth, for the convenience of taking them out; but as the light is frequently found to act strongly upon them, and render them thick, I would recommend wrapping up the bottles in sheep-skin, or moist parchment, folding it round the neck, and tying it with several turns of pack-thread.

The best vessel for holding your varnish while using it, is a varnish-pan, which may be had at any colour-shop. It is made of tin, with a false bottom; the interval between the two bottoms is filled with sand, which, being heated over the fire, keeps the varnish fluid, and makes it flow more readily from the brush. There is a tin handle to the pan, and the false bottom comes sloping from one end to the other, which causes the varnish to run to one end.

Very great caution is required in the making of varnish—a process in which most serious accidents have frequently occurred.

As heat in many cases is necessary to dissolve the gums used in making varnish, the best way, when practicable, is to use what the chemists call a sand-bath,

which is simply placing the vessel in which the varnish is in another filled with sand and placed on the fire; this will generally be sufficient to prevent the spirits catching fire; but in case of such accidents, (which not unfrequently happen,) it will be best to take a vessel so large that there shall be little danger of spilling any—indeed, the vessel should never be more than two-thirds filled; but in case of accidents, have ready at hand a piece of board sufficiently large to cover the top of the vessel, in case of its taking fire, as also a wet wrapper, in case it should be spilt when on the fire, as water by itself thrown on it only increases the mischief. The person who attends the varnish-pot should also have his hands covered with gloves, and if these are made of leather, and rather damp, it will effectually prevent injury.

In addition to the compound colors given on p. 104, the following receipts by L. E. Andès may be of interest. The figures refer to parts by weight, and the ingredients are to be mixed with linseed oil.

Zinc gray. White lead 25, barytes 30, lamp-black 2.

Silver gray, I. White lead 25, barytes 30, graphite 4.

Silver gray, II. White lead 25, barytes 30, graphite 5.

Iron gray. White lead 25, barytes 30, graphite 7.

Stone gray. White lead 25, barytes 30, chrome green 2, lamp-black 2.

Pearl gray. White lead 25, barytes 30, ultramarine 2, lamp-black 2.

Imperial gray. Zinc white 20, graphite 30, barytes 15.

Diamond color. White lead 20, barytes 25, whiting 15.

Bridge gray. White lead 30, barytes 15, ochre 3, Paris blue 1, lamp-black 2.

Gray grounding paint. White lead 20, whiting 20.

Leaf green. Chrome green, light or dark, 22, barytes 10.

Imperial green. Schweinfurth green 13, zinc white 12.

Oak color (*pale*) I. French ochre 25, white lead 6.

II. White lead 6, French ochre 25, barytes 15.

III. White lead 6, French ochre 25, barytes 25.

For producing the three kinds of *dark oak* use the same quantities and ingredients, but substitute dark ochre for the French ochre.

Ochre yellow. French ochre 22, barytes 10.

Tile red. Venetian red 20, barytes 10.

Brick red. Venetian red 20, barytes 10, ochre 10.

Brown. Umber, light or dark, 21, barytes 10.

Chrome yellow. Chrome yellow 20, white lead 5, barytes 10.

Minium red. Red lead 20, barytes 15.

Ultramarine blue, I. Ultramarine blue 7, zinc white 10.

II. Ultamarine blue 7, zinc white 10, barytes 5.

In mixing different colored paints to produce any desired tint, it is best to have the principal ingredient thick, and add to it the other paints thinner. In the following list of the combinations of color required to produce a desired tint, the first-named color is the principal ingredient and the others follow in the order of their importance. Thus, in mixing a limestone tint, white is the principal ingredient and red the color of which least is needed, etc., the exact proportion of each depending on the shade of color required.

Buff. White, yellow, ochre, red.
Chestnut. Red, black, yellow.
Chocolate. Raw umber, red, black.
Claret. Red, umber, black.
Copper. Red, yellow, black.
Dove. White; vermilion, blue, yellow.
Drab. White, yellow, ochre, red, black.
Fawn. White, yellow, red.
Flesh. White, yellow, ochre, vermilion.
Freestone. Red, black, yellow, ochre, white.
French gray. White, Prussian blue, lake.
Gold. White, stone ochre, red.
Green, bronze. Chrome green, black, yellow.
Green, pea. White, chrome green.
Lemon. White, chrome yellow.
Limestone. White, yellow ochre, black, red.
Olive. Yellow, blue, black, white.
Orange. Yellow, red.
Peach. White, vermilion.
Pearl. White, black, blue.
Pink. White, vermilion, lake.
Purple. Violet, with more red and white.
Rose. White, madder lake.
Sandstone. White, yellow ochre, black, red.
Snuff. Yellow, Vandyke brown.
Violet. Red, blue, white.

PRACTICE OF PAINTING.

A PAINTER will consult durability in preference to beauty of appearance, or the reverse, according as his work is to be more or less exposed to the weather. In out-door work, durability is, of course, of the most consequence; and as it is likewise the simplest kind of painting, I shall begin with noticing the manner of executing it.

Before attempting to lay any colour upon your work, you must carefully fill up with putty, so as to make the whole surface perfectly level, all flaws, cracks, openings, nail-holes, &c.; for, if this be not done, the rain and snow will be sure to penetrate into these places, and quickly destroy the fruits of your labour. All knots and unevennesses must likewise be carefully removed. When these points are accomplished, proceed to the *priming* of the work; that is, laying on the colour which is to serve as a ground for the succeeding coatings. The nature of the priming will, of course, be regulated by that which the surface is ultimately to receive. Sufficient time must be allowed for this to dry, according to the state of the weather: from two to three days will generally be enough. When the wood is new, or great solidity required in the work, it may be proper to repeat the first priming; otherwise. when that is dry proceed to put on

the first coat of your proposed colour, and afterwards the others in succession, as each of the preceding ones becomes dry. The number of coats applied will depend upon the agreement made, and upon how far the work is wanted to be finished and substantial.

When the wood you are about to colour is new, the priming should be laid on as thin as possible; because, in this case, the quantity of oil which necessarily sinks into the wood is very useful in preserving it. This thinness of the priming in new wood is also the reason why, as before observed, it is proper to repeat it. But as the thinness tends to delay its drying, if the priming colour be one that is naturally hard to dry, do not mix it with plain linseed oil, but with one part of drying oil and two parts of linseed oil; or if the priming colour be white or blue, mix it with linseed oil as usual, but grind a small portion of white copperas along with it, because the two colours just mentioned are affected in their tints by the drying oil.

No new coating of colour ought ever to be applied till the former is perfectly dry, which can never be the case while the least stickiness is felt on applying the hand to it. The neglect of this precaution is certain to ruin all the beauty of painting. Great care should likewise be taken to brush off any dust which may have settled upon the former coat before applying a new one; for, if it be allowed to remain and mix with the colour, the uniformity of the tint will be destroyed, particularly in bright colours. The workmen ought to be very careful that every coating is of the same thickness throughout,

or the work, when done, will have an unfinished and slovenly appearance. This forms an additional reason for always mixing as much colour at once as is necessary for the job to which it is to be applied. The proper thickness of each respective coating can only be learned by habit and experience. If too thin, it often cracks in drying; if too thick, it becomes blistered, wrinkled, and unequal. The first coating, however, may always allowably be made much thinner than any of the succeeding ones.

Practice, too, is necessary, in order to obtain even the proper use of the brush, and to learn the art of varying its strokes according to circumstances. Sometimes long strokes are to be employed to extend the colour in a uniform manner; at other times the colour should be laid on in repeated dabs, for the purpose of incrusting it in recesses and places where the surface is unequal. The test of the complete workman in this respect is to leave no marks of the brush behind him.

The same general directions that are given for outside painting will apply to inside work; but, in this latter, more finish and delicacy of execution are necessary than in the former; and, as it is not so much exposed to injury from the effects of weather and the state of the atmosphere as the work done without-doors, the painter is not obliged to pay so much attention to durability, but, in the choice and application of his colours, principally to regard beauty and effect. In inside work, the surfaces to be painted are frequently composed of fir or deal, in which kinds of wood, particularly when new,

there are usually a great many resinous knots. If these be permitted to remain, the colour will run into them and not adhere. Before beginning to paint, you should, therefore, saturate these knots with a mixture of red lead and litharge with a small quantity of oil of turpentine.

The panelling of wainscot, and other similar parts of inside work, will give you frequent occasion to employ very small brushes or pencils. In using these, you should not take your colours out of a pot or pan, but have those that you want disposed upon a palette. There is more than one advantage attached to this. In the first place, if your pencil be only dipped into a pot of colour, it brings out with it no more than hangs on the outside—a quantity, from the small size of the brush, that will go but a little way in working; whereas, if you work and temper the colour by rubbing the pencil about in it upon the palette, it will imbibe a considerable quantity of the colour. In addition to this, you will likewise, by this method, be able to work your pencil to a point, which is a great advantage in fine painting and drawing lines, and which you could never obtain by taking your colour upon it out of a pot.

Painting in Distemper.

The leading difference between oil-painting and painting in distemper is, that in the latter the colours, instead of being prepared with oil, are mixed with size and water. This circumstance renders many colouring sub-

stances, particularly some that contain chalk or clayey earth, or are extracted from vegetable matter, proper for the purpose of distemper, which cannot be used in painting in oil.

Almost all colouring substances which can be used in oil-painting are applicable in distemper; but the reverse, as will appear from the remarks I have just made, is far from being the case. In speaking of colours, care has been taken to notice particularly such as, from their nature, can be employed only in distemper.

In painting in distemper, it is advisable to apply all the coatings, except the last, warm; not, however, in a boiling state, for that is injurious, and may cause wood to split. Besides, if the size be too much heated, it becomes fat, and will not adhere. In putting on fresh coatings, be very careful to preserve an equal thickness throughout.

Without the utmost attention to having the ground you are to work upon perfectly clean, no pleasing effect can ever result from distemper. Grease and lime on the surface that is to receive it would ruin all. They must be removed by scraping if the surface be a wall, and by a solution of pearlash if it be wood. Canvas must be cleaned by means of a ley.

When the wall or surface is very smooth, a coating of warm glue is first applied; but if rough, a coat of Spanish white, or chalk mixed with a solution of glue, is employed to render the surface smoother; and when the coating is dry, it is scraped as clean and as even as possible. A level surface is indispensable to receive dis-

temper. If there are any considerable inequalities or holes, they must be filled up with gypsum, and time allowed, before applying any coat, for that gypsum to gain body, which will not be the case before it is thoroughly dry.

In painting in distemper, the thickness of the colour, contrary to the observation I made on that head in oil-painting, should be such that it may run or drop from the brush in a thread when taken from the pot. If the colour do not form a thread, it is too thick, and the work is likely to become scaly.

Distemper is much used in the interior of houses, and, when well executed, has a very delicate and beautiful appearance. It is likewise free from the disagreeable smell which usually arises from the turpentine in oil-painting. It is, however, far inferior to oil, both as to the durability of the colours and to the preservation of the surfaces on which it is applied. In some cases, too, it is attended with the inconvenience of not enabling the workman to see what effect a particular mixture will produce when it is dry. When this happens, the only method of obviating the evil is to try each mixture on pieces of prepared wood having the same tint as the ground on which you are working, so as to obtain the real tint.

A kind of distemper, called by the French *badigeon*, is sometimes used in out-door work, to give a uniform tint to houses rendered brown by time, and to churches where it is required to render them brighter. It has generally a yellow tint. The best kind is made by mix-

ing the saw-dust or powder of the same kind of stone and slaked lime, in a bucket of water containing a pound of alum in solution. The composition is applied with a brush

Painting in Milk.

In consequence of the injury which has often resulted to sick and weakly persons from the smell of common paint, the following method of painting with milk has been adopted by some workmen, which, for the interior of buildings, besides being as free as distemper from any offensive odour, is said to be nearly equal to oil-painting in body and durability.

Take half a gallon of skimmed milk, six ounces of lime newly slaked,* four ounces of poppy, linseed, or nut-oil, and three pounds of Spanish white. Put the lime into an earthen vessel or clean bucket, and having poured on it a sufficient quantity of milk to make it about the thickness of cream, add the oil in small quantities at a time, stirring the mixture with a wooden spatula. Then put in the rest of the milk, and afterwards the Spanish white.

It is, in general, indifferent which of the oils above-mentioned you use; but, for a pure white, oil of poppy is the best.

The oil in this composition, being dissolved by the

* Lime is slaked by dipping it into water, then taking the pieces out immediately and allowing them to slake in the open air.

lime, wholly disappears; and, uniting with the whole of the other ingredients, forms a kind of calcareous soap.

In putting in the Spanish white, you must be careful that it is finely powdered and strewed gently over the surface of the mixture. It then, by degrees, imbibes the liquid and sinks to the bottom.

Milk skimmed in summer is often found to be curdled; but this is of no consequence in the present preparation, as its combining with the lime soon restores it to its fluid state. But it must on no account be sour; because, in that case, it would, by uniting with the lime, form an earthy salt, which could not resist any degree of dampness in the air.

Milk paint may likewise be used for out-door objects by adding to the ingredients before-mentioned two ounces each more of oil and slaked lime, and two ounces of Burgundy pitch. The pitch should be put into the oil that is to be added to the milk and lime, and dissolved by a gentle heat. In cold weather, the milk and lime must be warmed, to prevent the pitch from cooling too suddenly, and to enable it to unite more readily with the milk and lime.

Time only can prove how far this mode of painting is to be compared, for durability, with that in oil; for the shrinking to which coatings of paint are subject depends in great measure upon the nature and seasoning of the wood.

The milk paint used for in-door work dries in about an hour; and the oil which is employed in preparing it

entirely loses its smell in the soapy state to which it is reduced by its union with the lime. One coating will be sufficient for places that are already covered with any color, unless the latter penetrate through it and produce spots. One coat will likewise suffice, in general, for ceilings and staircases; two will be necessary for new wood.

Milk painting may be colored, like every other in distemper, by means of the different coloring substances employed in common painting. The quantity I have given in the receipt will be sufficient for one coat to a surface of about twenty-five square yards.

A vehicle or agglutinant for pigments may also be prepared from caseine (curd). It is available for many purposes, but great care and accuracy are required in its preparation. The caseine vehicle—which for convenience sake may be called caseine varnish—can be combined with dry mineral pigments as well as with oil paints. It is a milky fluid with considerable consistency, a caseous odor and disagreeable taste; it is very sticky and dries very rapidly. Its specific gravity is, according to its consistency, from 2½° to 5° Bé. At 96° F. it decomposes rapidly and completely with the evolution of sulphuretted hydrogen. At a lower temperature decomposition also sets in after some time, but the varnish can still be used. The advantages of caseine varnish are: cheapness, slight odor and rapid drying, and its disadvantage: its rapid decomposition at a temperature of over 96° F.

For the preparation of caseine varnish, 64 parts of curd are thoroughly mixed with a quantity of water varying according to the desired density, and the re-

sulting paste is passed through a metal sieve. For the quantity of water required for the various degrees of density see the receipts below.

On the other hand, thoroughly burned lime is gradually slaked with sufficient water of 64.5° F. that it falls to a fine powder. Of this powder mix and triturate 1.5 parts with 7 parts of water, filter through paper and gradually add the mixture to the curd, stirring constantly. After adding the milk of lime the mixture becomes thick and only acquires a certain clearness and with it the proper consistency by continuous stirring. Old curd which has become sour is several times washed with hot water, and when cold used the same as fresh curd.

Care must be taken that the lime used is of a good quality and freshly burned, and that not too little nor too much water is used in slaking it. The curd must be very finely divided in the water, should not form lumps, and the temperature of the water must be exactly 64.5° F.

Thick caseine varnish of 5° Bé. Curd 64 parts, water of 64.5° F. 21.3.—Lime 1.5 parts, water of 64.5° F. 7.

Medium thick caseine varnish of 3½° Bé. Curd 64 parts, water of 64.5° F. 64.—Lime 1.5 parts, water of 64.5° F. 7.

Thin caseine varnish of 2½° B. Curd 64 parts, water of 64.5° F. 96.—Lime 1.5 parts, water of 64.5° F. 7.

Mineral pigments only can be mixed with caseine varnish, and these only a short time before the paint is to be used. Chalk, it is claimed, possesses the special property of yielding a white paint with caseine varnish. For painting wood, and especially iron, the mineral pigments must first be rubbed to a pasty consistency with linseed oil varnish and then diluted with caseine varnish.

Pure caseine paints. Black. Caseine varnish 100 parts, lamp-black 26.

Yellow. Caseine varnish 100 parts, chrome yellow 20.

White. Caseine varnish 100 parts, chalk 64.

White. Caseine varnish 100 parts, white lead 70.

Red. Caseine varnish 100 parts, vermilion 32.

English red. Caseine varnish 100 parts, English red 32.

Blue. Caseine varnish 100 parts, Prussian blue 16, white lead 8.

Green. Caseine varnish 100 parts, white lead 28, chrome green 42.

Ochre. Caseine varnish 100 parts, ochre 24.

Oil-paints with caseine varnish. Black. Caseine varnish 100 parts, lampblack in oil 30.

Yellow. Caseine varnish 100 parts, chrome yellow in oil 50.

White. Caseine varnish 100 parts, white lead in oil 100.

White. Caseine varnish 100 parts, chalk in oil 60.

Red. Caseine varnish 100 parts, vermilion in oil 100.

English red. Caseine varnish 200 parts, English red in oil 100.

Blue. Caseine varnish 80 parts, Prussian blue in oil 100.

Green. Caseine varnish 100 parts, chrome green in oil 100.

Ochre. Caseine varnish 233 parts, ochre in oil 100.

Paints with linseed oil varnish and caseine varnish. For this purpose the pigments are rubbed with water to a very thick paste, and the latter is intimately mixed first with the caseine varnish and then with the linseed oil varnish.

Black. Caseine varnish 100 parts, linseed oil varnish 20, lampblack 8.

Yellow. Caseine varnish 100 parts, linseed oil varnish 5, chrome yellow 14.

White. Caseine varnish 100 parts, linseed oil varnish 10, chalk 64.

White. Caseine varnish 100 parts, linseed oil varnish 10, white lead 84.

Red. Caseine varnish 100 parts, linseed oil varnish 4, vermilion 32.

English red. Caseine varnish 100, linseed oil varnish 40, English red 32.

Blue. Caseine varnish 100 parts, linseed oil varnish 15, Prussian blue 8, white lead 16.

Green. Caseine varnish 100 parts, linseed oil varnish 10, chrome green 42, white lead 28.

Ochre. Caseine varnish 100 parts, linseed oil varnish 10, ochre 24.

Silicate Paints.

When the surface to be painted is of a mineral nature, such as the exterior of a house, the pigments may be mixed with a vehicle consisting chiefly of waterglass, or soda or potash silicate. This method of painting requires some care, and a knowledge of the chemical nature of the pigments used. Some colors are completely destroyed by the alkali contained in the waterglass. Among those pigments which are not altered by the alkali may be mentioned carbonate of lime, barytes, zinc white, cadmium yellow, Naples yellow, barium chromate, chrome red, red ultramarine, blue ultramarine, cobalt blue, cobalt green, chrome green, ivory black. When a wall is to be painted, it should first be prepared with a mortar com-

posed of pure fat lime and clean sharp sand. The water should also be free from saline impurities, as these might subsequently effloresce and destroy the surface of the paint. When the surface of this plaster is dry, a weak solution of water-glass should be applied and the operation several times repeated.

For making the paint, dilute silicate of soda solution until it works well with the brush and add dry coloring matter such as will not be decomposed by the alkali ; ochres, Venetian red, smalts, umbers and siennas may be employed.

Rules for Painting.

The following *General Rules* may with advantage be laid down in painting: 1. Let the ground of your work be properly cleaned, prepared and dried. 2. See that your colors are equally well ground and duly mixed. 3. Do not mix much more, or any less paint than is necessary for the present work. 4. Keep the paint well mixed while the work is going on. 5. Have your paint of due thickness, and lay it on equally and evenly. 6. Do not apply a succeeding coat of paint before the previous one is sufficiently dry. 7. Do not employ a lighter color over a darker. 8. Do not add dryers to colors long before they are used. 9. Avoid using any excess of dryer, or a mixture of different sorts. 10. Do not over-charge your brush with paint, or replenish it before it is sufficiently exhausted. 11. Begin with the highest part and proceed downwards with your work. 12. Do your work to the best of your ability, honestly, for such you will find the best policy.

The paint used for priming is generally a mixture of white lead and red lead with a proper proportion of

driers, but when the finishing color is to be black, dark green, dark brown, etc., the priming may be done with a lead color made of vegetable-black and white lead in equal quantities. These colors should be mixed with boiled oil for out-door work, and with linseed oil for in-door work, a small quantity of turpentine being added in either case, the proportions being 3 parts of oil to one of turpentine. When the priming is dry it should be rubbed down with glass-paper, the operation being best performed as follows: A piece of paper should be wrapped round a flat piece of wood, about 4 inches long by 3 inches wide and 1 inch thick, forming a sort of brush, and this should be rubbed equally over the whole surface, which will thus be nicely smoothed, whilst its perfectly level character will not be injured. A piece of glass-paper which has several times been used in this way, should be saved for further use in the latter stages of the work, when great refinement is required. A strip of glass-paper may be wrapped over the edge of a piece of wood shaped like a chisel for use in the edges of panels and similar places, or round the finger, or a piece of rag for the carved parts of moulding, great care being taken that a stiff edge such as is formed by a sudden bend in the glass paper may not come in contact with the work, producing scratches which are very troublesome to get rid of. When the priming has been properly rubbed down, and all the nail holes, bad joints, cracks, etc., filled in with putty, the second coat is laid on. It should be observed that the second color for new work is made up chiefly with oil, as it best stops the suction of the wood, but the second color for old work is made up chiefly with turpentine, because oil color would not dry or adhere to it so well.

The color should be spread on as evenly as possible, and to effect this, as soon as the whole, or a convenient quantity is covered, the brush should be passed over it in a direction contrary to that in which it is finally to be laid off—this is called *crossing*. After the crossing it should be laid off softly and carefully in a direction contrary to the crossings, but with the grain of the wood, taking care that none of the cross brush marks be left visible. The criterion of good workmanship is that the paint be laid evenly and the brush marks be not observed. In laying off, the brush should be laid into that portion of the work already done, that the joining may not be perceived. Every coat should be perfectly dry, and all dust carefully removed before the succeeding one is laid over it.

In the third painting the oil and turpentine should be used in equal proportions, and some approach is made to the finishing color. Thus, if the finishing color is to be lavender, the third coat should consist of white slightly tinted with that color. In some cases it is desirable that the coat preceding the finishing, should be darker than that which is to be laid over it. In fact, some authorities claim that the only way to produce solid uniform work is by making every succeeding coat lighter in tint than the one which preceded it. No matter what the finish is to be, the first coat should always be darker than the one which succeeds it; and the darker the shade of the finishing coat, the more important it is that this rule should be observed.

The fourth may be considered as the finishing coat, and must not be applied unless the third coat proves perfectly satisfactory, that is, unless the surface has dried absolutely uniform, as regards surface; for if one

part is glossy and the other dull, it will be clear that the absorbent quality of the wood is not stopped and the third painting must be repeated.

In repainting old work the surface should first be gone over with the stopping knife, removing all excrescences, and it is then to be rubbed with pumice stone and water, the greasy parts being well rubbed with turpentine. Parts from which the paint has been entirely removed, must then be gone over with a coat of priming color, and cracks, nail-holes, etc., are to be filled up with putty. The first coat is then to be given, and this is to be mixed with turpentine. The quality of the next coat will depend on the manner in which it is to be finished. If it is to be painted twice in oil, and flatted, the next coat should be mixed up chiefly in oil, and tinted like the finishing color to form a ground for the flatting. The greater the gloss of the ground the more dead will be the finishing coat or flatting, likewise the more dead the ground the better will the finishing oil shine. It is, therefore, a general rule, that for finishing in oil, the under coat should be turpentine, and for finishing flat, the under coat of ground color should be oil. But all turpentine grounds must have a little oil mixed with them, and all oil under coats must have a small quantity of turpentine added to them, excepting the priming or first coat in new work.

Flatting

Consists in employing spirit of turpentine instead of linseed oil in the diluting of the color, so that no more oil is used than is necessary to bind the paint and fix it on the ground, and not sufficient to make it bear out with the gloss of ordinary oil painting; a third or

fourth of the oil being sufficient. This mode is, of course, only suited to internal and delicate work in which the change of color and glare of light are to be avoided, and it might in some cases appear to advantage mixed and comparted with ordinary painting, diversified by dead color and gloss; or the latter may be produced by varnish.

The priming, under the same conditions, is the same for wood, plaster, stucco, and stone; but for paper and canvas, which are made rotten by oil, the priming must be of size, and for iron work, first freed from rust, it must in all cases be of oil, avoiding the use of copper greens as a first coat. For small works, primed canvas may be obtained from the colormen. Dryers are requisite in priming as they dispose the upper painting to dry quicker and unite better. Sponging with water previous to applying each coat of paint disposes it to work and unite better, and in work exposed to the sun prevents blistering.

Fresco.

The art of painting in fresco is naturally adapted to decorative painting, and the zealous attention of eminent artists having been turned to the revival of this great and free mode of art, we can not withhold our observations thereon.

It is hardly necessary to inform the reader, that *fresco painting* is performed with pigments prepared in water, and applied upon the surface of *fresh laid plaster* of lime and sand, with which walls are covered; and as it is that mode of painting which is least removed in practice from modelling or sculpture, it might not improperly be called *plastic* painting; for which the best lime, perfectly burnt and kept long

slacked in a wet state, is most essential. And as lime in an active state is the common cementing material of the ground and colors employed in fresco, it is obvious that such colors or pigments only can be used therein as remain unchanged by lime. This need not, however, be a universal rule for painting in fresco, since other cementing materials, as strong or stronger than lime, may be employed, which have not the action of lime upon colors—such as calcined gypsum, of which plaster of Paris is a species—which being neutral sulphates of lime, exceedingly unchangeable, have little or no chemical action upon colors, and would admit even Prussian blue, vegetal lakes, and the most tender colors to be employed thereon, so as greatly to extend the sphere of coloring in fresco, adapted to its various design; which basis merits also the attention of the painter in crayons, scagliola, and distemper.

So far, too, as regards durability and strength of the ground, the compo and cements so generally employed in architectural modelings, stucco and plaster, would afford a new and advantageous ground for painting in fresco; and as it resists damp and moisture, it is well adapted, with colors properly chosen, to situations in which paintings, executed in other modes of the art, or even in ordinary fresco, would not long endure.

As these materials, and others now in use, were either unknown or unemployed by the ancient painters in fresco, their practice was necessarily limited to a small number of pigments; but every art demands such a variation in practice as adapts it to circumstances and the age in which it is exercised, without attention to which it may degenerate, or at best remain stationary, but cannot advance.

Although differing exceedingly in their mechanical execution, the modes of fresco, distemper, and scagliola agree in their chemical relations: so far, therefore, as respects colors and pigments, the foregoing remarks apply to these latter arts.

Scagliola.

This requires all the attention of the fresco painter in respect to the materials employed, and the skill of the grainer in imitating marbles, but comes nearer to the Plasterer's than the Painter's Art, although the Decorator is best qualified for its performance. Its basis is plaster of Paris mixed with the colors of fresco, laid on a solid ground of plaster or cement, according to the design, and, when dry and hard, it is polished.

CLEANLINESS IN WORKING.

THE principal end aimed at by the Painter, Gilder, or Varnisher, and especially by the last two, is to beautify; and, without the strictest cleanliness, it is obvious this end can never be answered.

Every surface to which colour, varnish, or gilding is to be applied should first be thoroughly cleaned; it should be rubbed, brushed, and even washed, if necessary; in the last case, however, it must be well dried afterwards.

When any surface which is to be varnished or painted has been previously varnished, and is found to be incrusted with dust or dirt, soap and water must be applied gently with a sponge, and great care taken every time, after the sponge has been rubbed over the varnish, to rinse it in clean water, and to squeeze it thoroughly out before it be again dipped into the soap and water.

In grinding colours, after you have ground as much of any one sort as you want, before you proceed to place any other kind upon the stone, let it be perfectly cleaned from the former colour, by first rubbing it with a cloth and fine dry ashes or sand, and afterwards with a little spirit of turpentine; then let it be well wiped with a rag, or with leather shavings.

But of all things in which cleanliness is essential, brushes and pencils are, perhaps, the most to be considered. With regard to the painter, where the very greatest nicety is required, a separate brush or pencil should be assigned to each colour, wiped when the work is done, and preserved by covering it with water. With artists, this is an invariable rule, but the occupations of the mechanical painter are hardly ever of such extreme delicacy as to require him to adopt it. In general, it is sufficient for him to carefully wash out every brush or pencil after he has done with it, or before he employs it for any other colour than that with which he has been previously using it. This washing out should be first in the oil with which the colour has been ground or mixed, (but neat linseed oil, or oil of turpentine, will always sufficiently answer for general purposes,) and afterwards in warm soap-suds. Brushes that have been used for varnishing may, on an emergency, be tolerably washed out with boiling water and yellow soap only. It is, however, much better to wash them well first with spirit of wine, if the varnish has been compounded with spirits, or with oil of turpentine, if it has been prepared with any description of oil; and, in either case, to clean them thoroughly with warm soap and water. The spirits used for washing varnish brushes are not thereby rendered unfit for use in preparing varnishes for common purposes. Remember, if either oil or colour be once allowed to dry in a brush or pencil, it is spoiled for ever. For coloured varnishes, kept in small quantities, a brush may be appropriated to each exclusively, and

left in the bottle; but in this case the cork should be perforated so as to fit the handle, and the points of the hairs should dip into the varnish; the brush will then be always ready for use. A common mustard bottle will in general answer the purpose.

DIRECTIONS FOR GRAINING AND IMITATING WOODS AND MARBLES.

1.—OAK.

IMITATION of OAK being so much in demand, it is of importance that the pupil should practise upon it before any other wood; for that purpose you will require the following tools:—

Combs.

Gutta percha is the best material for making combs; it is cheap, wears well, is easily cut into any size or form, and makes clean work. Purchase a piece of gutta percha, one foot square and one-eighth of an inch thick, cut it into squares, varying from one to four inches, and be particular in cutting the edges straight; take one of the squares, and with a pen-knife cut the edge to the depth of a quarter of an inch, leaving a small space between each tooth. If you cut in a slanting direction each way, you will thereby form the teeth of the comb and the space together; by this method you can make them fine or

coarse, to suit your work. For very particular work I use two or three combs made of cork; they are objectionable for general use, as they soon wear out. Take a flat piece of fine-grained cork, as free from holes as possible, square it as truly as you can, cut the square edge into teeth to the sizes you want, leaving the teeth as square and evenly cut as possible; these, with two or three of the finest cut steel combs, are all you require.

Brushes.

1. Common pound-brush and sash-tool.
2. Long hog's-hair overgrainer.
3. Badger-hair softener.
4. Sponge.

Colours, &c.

Vandyke brown, both ground in oil and water.
Raw and burnt sienna, do.
Turkey umber raw and burnt, ground in oil.
Oxford ochre, do.
Sugar of lead, do.
Blue black, ground in water.
Bees-wax, linseed oil, and turpentine.

The above colours are all that are necessary for any description of oak.

You will require a few smooth boards for practising upon. Bastard mahogany or baywood is the best wood to make them of, as it is not so liable to warp as deal. The best size is about two feet by one foot.

Prepare them with four coats of paint in the usual way, taking care to get them up as smooth as possible; the best ground colours are made from the following colours mixed with white lead:—

For light oak—Oxford ochre and white.

Middle shade—Oxford ochre, with a little Venetian red.

Dark oak—Oxford ochre, orange chrome, Venetian red, and burnt umber.

Graining Colour.

For light oak, mix two-thirds linseed oil with one-third turpentine; add a little Vandyke brown or burnt umber. If you want a warm colour, add burnt sienna; if a yellow colour, add raw sienna or Oxford ochre. Melt bees-wax in oil, and mix a small quantity with the colour: this is to prevent the colour from running when you have combed it. You must take particular care that it is well mixed together. Add to the above a quantity of sugar of lead or other dryers, then strain it through a double fold of fine muslin

Your graining colour being now prepared, brush over your board with it, taking care not to put too much on; if you do so you will make dirty work: lay it quite level, and uniform in colour. Now take a gutta percha comb, and draw it straight down the full breadth of the comb, beginning at one side of the board; by slightly inclining the comb you will make the grain finer. Now take a fine steel comb, and go over the whole of the previous combing in a slightly

waving or zigzag manner; practice will soon enable you to do this with ease. You must get a piece of real oak, and endeavour to imitate the natural grain; if you can get a piece full of figure or veins, so much the better, as it will be the best guide you can have Your board being combed, you must now take a piece of soft rag and double it over your thumb, holding it tight on the end of the nail, and try to imitate the figuring on the real oak. You may make some excellent figuring by using the blank end of the steel comb with the rag over it. You will find it very difficult to do this at first, but you must in this, as in every thing else, adopt the motto, "that if at first you don't succeed, try, try, try again." Do not practise too much from one piece of oak, as by doing so you are apt to acquire a stiff and formal style, but endeavour to vary it as much as possible. You have now combed and figured it: when dry it is ready for overgraining; for that purpose you will want a sponge, a basin and plate, fuller's earth, Vandyke brown, a little blue black, some stale beer, badger-hair softener, and overgrainer. Put some water into the basin, dissolve a little fuller's earth in it; wet your sponge with this and rub over your board; now take a little of the Vandyke brown, with a small quantity of the blue black, and mix them together with weak beer in the plate; dip your overgrainer into this mixture, and draw it straight down or across the board; soften it a little with the badger: this, if properly done, will give it a natural and pleasing appearance. By making the

ground and graining colours darker, you can produce any shade of oak in the same manner. To produce a rich dark old oak you must proceed as above, and then glaze it over as follows:—Mix some black japan with turpentine and a little boiled oil; add a little burnt sienna or Victoria lake, and go over the whole of the work with it. This mixture will give it an exceedingly rich appearance when varnished.

2.—SPIRIT COLOUR.

This colour is not so good as oil colour, but is very useful at times on account of its quick drying qualities. It is made as follows:—Grind a quantity of the best washed whitening in turpentine, mix with it either Vandyke brown, burnt umber, or Oxford ochre, ground in oil, in quantity according to the shade you want; add to this a sufficient quantity of turpentine varnish to bind or fasten the colour; thin it with turpentine; rub your panel in and comb it quickly, or it will set before you can do so. It dries quite dead when it has stood a short time. Take a flat hog's-hair fitch, dip it into a solution of Scotch soda and water with a little burnt sienna mixed with it; mark out your figure with this, taking care not to put too much on, or it will run; and remember that wherever the soda touches it will destroy the graining colour. When you have figured your panel, wash off quickly with a sponge and plenty of clean water; the figure will stand out clear and bright. Now go over the

whole with a brush and weak beer, and overgrain in the usual way. By this method you may grain and varnish a door in a couple of hours' time.

3.—POLLARD OAK.

This oak is interspersed alternately with knots and figuring, generally arranged in a waving and graceful form. To grain this wood in oil colour, proceed as follows:—Rub in with your light graining colour, mix a little colour several shades darker, put a touch of this colour here and there, according to the size you want the knots; with the same colour put in a few strokes, in sweeping or graceful lines, from one mass of knots to another; now comb it with a coarse comb in the direction of the knots, sweeping round them with the comb; where you cannot do this, you must work it out with your nail and the rag, keeping all in an easy flowing style. It is only by constant practice that you will be enabled to do this with freedom. Now figure it, starting from the knots in very fine strokes, gradually enlarging as you get into the plain spaces. To overgrain this, proceed as before, and shade across the grain and amongst the knots. Generally speaking, wherever there is a twist or wave in the grain there will be a shade. Now take a pencil and touch up the grain about the knots, and put strokes of dark colour across them, to imitate the cracks you may see in nearly all knots.

4.—ROOT OF OAK.

This oak consists of a succession of masses of knots with the grain twisting and curling round each knot and mass of knots, running into and round each other; what figuring it has is very small, and runs with the grain. It may be done in exactly the same manner as the pollard oak, and enriched by glazing with the dark oak glazing colour.

5.—TO GRAIN POLLARD AND ROOT OF OAK IN DISTEMPER.

Damp down your work with the sponge and fuller's earth, mix Vandyke brown with a little burnt sienna, dip a clean sash-tool into beer, then into the colour, spread it on to your work, using it freely. Now take your tool and a little dark colour, and press it against the panel here and there, making the hairs spread out; then suddenly draw it away, soften it a little with the badger; take a small round hog's-hair quill tool, dip it into dark colour, hold it between your right-hand finger and thumb, put the point against your work in the places where you have pressed your large tool, give it a sharp twist; by doing this properly you will form the imitation of a knot. When dry, use the small overgrainer and weak colour; dip the overgrainer in, then draw a common comb through it to

separate the hairs; now draw it across the panel, giving it a sort of half-circular stroke, slightly zigzag; while it is wet badger it, taking particular care only to use the badger one way, either up or down. By doing this carefully, you will form a light and dark grain at the same time. When you have sufficiently practised this method you will be able to produce some very good effects.

6.—WALNUT.

Walnut may be imitated in exactly the same manner as the above, using more black in your graining colour.

7.—BIRD'S-EYE MAPLE IN DISTEMPER.

This is one of the most delicate and beautiful of woods, and requires great care and cleanliness in working. To imitate it you will require the following tools:—Badger; one 4-inch hog's-hair mottler; one thick 2-inch hog's-hair mottler; one 1-inch short-haired hog's-hair mottler; one 3-inch, 2-inch, and 1-inch camel-hair mottlers; one 2-inch sable-hair pencil overgrainer; a single pencil.

The best ground colour for graining maple upon is a light cream colour, and the best colour to grain it with is Vandyke brown, mixed with a little raw sienna. Rub over your panel with a damp chamois or wash-leather; dip a large sash-tool into stale beer, then into

the colour; spread it evenly on your work, badger it until you get it as uniform in colour as possible; take the large hog's-hair mottler, damp it with clean water; now begin at the top of your panel, and with the end of the mottler touch the panel, drawing it down at the same time for about half an inch, holding it in an angular direction; by doing so you will take off a slanting strip of colour. Go on in the same way to the bottom of the panel, leaving unequal strips of light and shade; now go over this again in the same way, but holding your mottler in the opposite direction; you will form a sort of irregular checkered pattern; lightly badger this across the panel until it appears soft and mellow; now slightly soften in an upward direction. As you become used to the tools, you will be able to modify the figure and give variety. Now take your short-haired hog's-hair mottler, damp it, and with one corner of it take off a touch of the colour on the top of each shade; these are to imitate the bright light, or reflection, that accompanies a knot or bird's-eye; with a pencil, and dark colour, form the eye just under the extreme point of the bright light; for common work, a dot with the end of your finger will suffice.

To overgrain this, take a little of the colour and tint it with a small quantity of Indian red, or lake; you must only have it of sufficient depth of colour barely to show on your work; if too deep it looks coarse. With a pencil and this colour begin to curl a fine line round one of your principal knots, gra-

dually extending from one to another, keeping either in the centre or to the side of the panel until you have carried it from top to bottom. Now take your pencil overgrainer, dipped in the same colour, and draw it down parallel with your pencil-work, and fill up the rest of the panel with it.

8.—TO GRAIN MAPLE IN OIL.

I am not aware that any one has attempted to grain this wood in oil before I did, and I have only taught it to two grainers. It takes considerably more time to execute than in distemper; but, if well done, it is infinitely superior in every respect. The ground should be got up very smoothly, in such a manner that you will not have to use sand-paper on the last coat. Prepare your colour in the same way as the light oak graining colour, using Vandyke brown and a little raw sienna to stain with; strain it well, taking particular care that it is free from the slightest particle of grit; rub in your panel with it; take a damp wash-leather, roll it up tight, and use it as a mottler; soften well with the badger; get a pencil-stick, cut one end of it into an oval form, wrap a strip of wash-leather round the oval, in such a manner that only one thickness of it will appear round the end of the oval; tie it fast; now dip it into dark colour and dot in the eyes with it, then use the leather on your thumb-nail to form the bright lights springing from

the knots or eyes; when dry, you can overgrain it either in distemper or oil.

9.—SATIN-WOOD.

The proper ground for this wood is a yellow cream colour, made from Oxford ochre and chrome yellow. The best colour to grain it with is sienna, with a slight touch of Vandyke brown and burnt sienna mixed with it. This wood has a great similarity to mahogany in the form of its grain; if you can grain one well, you can the other. Rub in your colour, using beer and a sash-tool; dip a sponge or wash-leather in clean water, and draw it down your panel, partially clearing off the colour in places as you go on. Now take the mahogany, or thin hog's-hair mottler, and cut out portions of the colour that is left on the panel; in this way you will form the lights or reflections you may see in the real wood, or in a piece of Spanish mahogany, which will do as well; they are just the same, only not so large. Badger it cross-way of the panel; you must occasionally use a camel-hair mottler; press it against your work, and draw it down with a slight jerking motion; this will form a very close and regular mottle. To overgrain it, use the mahogany overgrainer, or flat sable, (divided with the comb,) dipped into a tint of blue black in weak beer. To imitate the curl, or feather, lay on very light colour freely; then take a small tool, or flat fitch, and with colour several shades darker make a succession of half-

circles, one above the other, beginning at the bottom of the panel, gradually reducing the sweep of the circle as you rise to the top. While it is wet, take the mahogany mottler and cut out the lights, spraying them from the centre of the circle each way. Overgrain as before, taking care to run the grain in the same direction as the half-circles.

10.—MAHOGANY IN DISTEMPER.

Ground colour made with red lead, Venetian red, and orange chrome: graining colours, Vandyke brown, burnt sienna, and Victoria lake. This lake is not much known as a graining colour; there is no colour equal to it for mahogany. To grain this wood you must proceed in exactly the same manner as for satinwood, with this addition, that while the colour is wet you must stipple or dapple it all over with the end of the badger, to imitate the pores of the wood; this will give it a very natural appearance. Overgrain with Vandyke brown and blue black.

11.—MAHOGANY IN OIL.

Mix a light colour in exactly the same way as for light oak, using burnt sienna to stain with; rub in your panel with it, mix a dark colour with Victoria lake and Vandyke brown; use this with a small tool or fitch to put in the dark shades; mottle it with a piece of stiff card-board, or a rag or leather drawn tight

over a steel comb; badger it well. When dry, glaze it all over with Victoria lake in distemper, and while wet, stipple with the end of the badger, and overgrain as before.

12.—ROSEWOOD.

Rub in with a light distemper colour, made with Vandyke brown and burnt sienna; take a sash-tool and dark colour, made with Vandyke brown and Victoria lake, and put in some broad irregular shades, leaving light spaces running between: now use your overgrainer and blue black, curling or crossing the dark parts, making some straight, others broken, just as you see it in the real wood; where you cannot use the overgrainer with effect, use a pencil; when dry, glaze it all over with Victoria lake in oil, wiping it out in places. This will give it a very rich appearance.

The foregoing are all the woods that need be described here,—in fact, all that are adapted to general use. If you can grain these well, you will be able to imitate any other on exactly the same principles.

MARBLES.

The following are the principal marbles for adaptation to general use in decoration :—

Sienna,	Italian Jasper,
Black and Gold,	Dove,
Saint Ann's,	Black Bardilla,
Verd Antique,	Derbyshire Spar, and
Egyptian Green,	Granites.
Rouge Roi,	

Sienna.

This marble is the most useful of any, as it is well adapted for decorating halls, staircases, &c. Out of a variety of ways of doing it, the following is the best :—Prepare your ground-work as smoothly as possible, with a light buff colour made from Oxford ochre; mix a variety of tints as follows :—Dark vein colour, made with ivory black and Indian red; by adding white to this you will produce a few different shades of neutral tints. Make a few tints from Indian red and Prussian blue, with white: place these conveniently on a large palette; now give your work a thin coat of the buff paint; while wet, take a large feather, dip it into turpentine, then into the dark vein colour; with this form a leading vein right across your panel or slab, giving it a broken or irregular appearance; strike a few straggling veins from this; now use your feather and neutral

tints, and put in some smaller veins, breaking it into small irregular pieces on, or springing from, the leading vein. Avoid as much as possible giving it that formal appearance which so many grainers affect, as it is unnatural. Always remember this, that there is very rarely, if ever, a circle, a square, or a straight line in any marble. Now badger it well until it is soft and mellow; when dry, take a piece of old silk, dip it into linseed oil and rub it very sparingly over the work; now take a feather and thin white mixed with turpentine, go over your work with it, touching it in an irregular manner in and about the veins; soften or blend it with the badger as you go on, then put in a touch of solid white here and there among the veins. Now use Oxford ochre and raw sienna, with occasionally a little crimson lake; with these glaze over your work in parts, taking care always to put the darkest parts in connection with the leading vein; now use a pencil and ivory black, and put in some sharp touches on and about the leading vein; this, if properly done, will make the veins appear sunk, or give them depth.

Black and Gold Marble.

Prepare a smooth black ground; slightly oil it; place on your palette some white, Indian red, Oxford ochre, black, and a little orange chrome; now use a large pencil, and take up a portion of the whole or part of these colours on your pencil; roll it across or lengthways of your board, leaving it in irregular patches; now connect these patches together by fine lines in the same

colours; fill up the panel with irregular fine lines, running in the same direction, with short lines or touches crossing and connecting them; now use a dark lead colour, and fill in the spaces between the lines in parts with it, then put here and there on the top of these a touch of a lighter lead colour; when dry, you can cut the patches of colour into better form, if required, with black and a pencil, and give them depth by glazing in places with touches of white.

Saint Ann's.

This marble is very similar in the form of its vein to black and gold: the patches of colour are much smaller and more crowded together; it is done in exactly the same manner on a black ground, using white alone for the veins, then fill up the same with lead colour.

Verd Antique, or Ancient Green.

This marble is done upon a black ground; oil the work as before; mix several shades of green, made from Prussian blue and chrome yellow; arrange these on your palette, and a little Indian red. Take a feather, dip it into your darkest green, and go over the whole of the panel with it, using it freely; follow in the same manner with the lighter shades, occasionally using a little of the Indian red; then take some black, and put in a quantity of irregular broken patches with it, allowing the green to run in broken lines through them; now put in some solid patches of white, in form like broken pieces of flagstone or earthenware, and in

size from a quarter of an inch to two inches. When dry, glaze over all with a green, made with Antwerp blue and Italian pink, using also a little crimson lake; in places touch up the whites again, making some solid, others transparent; then edge them round with a fine line of black.

Egyptian Green.

Black ground. Take a sash-tool, and glaze over your work with the darkest green you can make from Prussian blue and chrome yellow; now use the feather and a lighter green, and streak your panel all in one direction, occasionally using a little Indian red; now dip your feather in a thin white, and streak it over the other in a slanting direction, giving it a slight curl, and crossing the first streaks; blend these well together; when dry, glaze it all over with a bluish green, made with Antwerp blue and Italian pink; this colour is perfectly transparent. Now touch up your light streaks here and there with white, and blend it well.

Rouge Roi, or Royal Red.

This is done upon a bluish gray ground. Oil the ground; mix burnt ochre with a little Indian red; rub in your panel with this. Mix a rich brown with Indian red and ivory black; cover a portion of the panel with this colour. Now take a piece of paper, and crumple it up in your hand; dab your panel all over with this; dip the paper into black, rub it slightly on your palette-board, to take off the superfluous black; then lightly

dab it on the dark parts of the panel; go over the whole of it in the same way with a light blue, then here and there with white. Now wipe out a vein in places with a rag, leaving the gray ground clear; make some long, running irregularly across the panel, others short, and varying in breadth from a fine line to an inch and a half; when dry, glaze it in places with Indian red and black, using the Indian red alone occasionally; make the veins pure white in parts, in others transparent.

Italian Jasper.

Ground colour, a light green drab; oil the ground. Mix together Indian red and Victoria lake; with this rub in several large and small patches, inclining to a circular form; mix a few olive green tints with white, blue black, and raw sienna, and several shades of gray made from ivory black and Prussian blue. Place these conveniently on your palette, also a little ochre; dip your feather into turpentine, and then into the olive tints, and run it between, and round, and across the patches of red; blend these well; then go over in the same way with the gray tints. When dry, glaze over the gray and olive tints with pure white, making them solid in places, in others transparent. Soften or blend it well; glaze the dark parts here and there with crimson lake; while this is wet, take a feather, or small overgrainer, dipped in very thin white, and draw it over some of the smaller of the dark parts, giving it something the appearance that an onion has when cut in half; touch up in places with dark colour.

Dove Marble.

Ground colour, a bluish lead colour. Dip your feather into turpentine, then into black ground in oil; streak your panel with this; use white in the same way; when the black has stood a little while, blend them well together as you go on; then put in a few touches of solid white, and soften.

Black Bardella.

Ground colour, a very light lead colour. With a feather and black, figure all over in lines running into each other, very close in places, some very fine, with short lines or strokes crossing; soften a little. When dry, glaze over with thin white, a little stronger in some places than others; touch up the lines with fine lines of black.

Derbyshire Spar.

This is a compound of the fossil remains of shell-fish and other inhabitants of the deep. Ground colour, a light gray. Glaze over your panel with a thin colour, made with Vandyke brown and black; rub in a little Indian red occasionally. Crumple a piece of paper in your hand, lightly dab your work over with it; now take a rag and a narrow square-pointed stick, and form the halves of shells, fish, bones, &c.; then spurt in a little turpentine,—this will open or spot it. When dry, glaze over with the same colours, and make the fossils partly solid with white; then sharpen or edge them with a fine line of black.

Granites.

There are several granites; they may be done almost any colour and yet be correct. The principal ones are the gray and the red, or Aberdeen granite. You may do them all in the same manner. Prepare the ground, if for gray, a light gray; if for red, a light salmon colour. Provide yourself with a flat brush made of very stiff bristles, about an inch long and four inches broad; shape a piece of wood about six inches square, with a handle to it something like a child's battledore; rub in your ground colour; now dip the flat brush in thin black, hold the wood in your left hand, and press the brush upon it, springing the bristles in the direction of the panel; this will throw the colour on in spots. Follow in the same manner with white, if for gray granite; and with black, red, and white, if for Aberdeen. They may be done in the following manner with good effect:—Provide yourself with a very porous or open sponge; dip it into black, mixed with beer; then stipple your ground with it; when dry, throw in your white in oil colour; and so on with any other colour. In all glazing colours it is advisable to use a little sugar of lead, as they are most of them bad dryers. I should also recommend Rowney's tube colours for finishing marbles, as they are the best colours, are very finely ground, and are as cheap in the end as any you may grind yourself.

To Polish Imitation Marbles.

When you have finished marbling, let the work stand for a day or two; then gently rub it down with the back or smooth side of a sheet of sand-paper; this will take off the knits or bits of skin which may be upon it, without scratching it; now give it three coats of the best pale polishing copal varnish, allowing an interval of two days between each coat. Let this stand for three weeks; then cut it down with ground pumice-stone and water, using a piece of wash-leather or rag for that purpose. When you have got it tolerably smooth and level, wash it well with plenty of clean water, taking particular care to clean off all the pumice-stone; give it five coats of varnish. It ought now to stand for three or six months, at the least, before it is polished, for if it is done before it is almost certain to crack. When the varnish is sufficiently hard, cut it down with finely-ground pumice-stone as before; then use rotten stone and olive oil, using the ball of the hand; then use flour and oil; finish off with dry flour. This takes a deal of time to do properly, if well done.

STAINING.

Staining is an important part of the painter's and varnisher's trade, and consists in the main in washing or laying on the stains in the form of mere washes, so as to change the shade of the wood to a darker or warmer color; or, at most, to make wood, which in its natural grain resembles another, correspond in color also. The wood to be stained should, if possible, be placed horizontally. If this cannot be done, as little of the stain as possible should be used, so that it may not run down and dry in streaks which would subsequently be darker than the general surface. A stain to show at its best must exhibit a tone of color which comes from a combination of the color of the wood and the pigment or stain used, on the same principle as glazing and graining. Hence the more transparent the color used the better the stain. To keep the ends of the work from taking so much pigment from the stain as to partially or entirely hide the grain and color of the wood, the use of transparent wax may be recommended. For this purpose warm small bits of the wax so that they will stick to the wood, then melt them down with a broad spatula or limber putty knife, heated over an argand lamp, or any other heater free from smoke. Melt down the wax and spread it on the surface and rub it into the pores. The ends may, of course, be filled with starch or silica fillers, but the trouble is to get enough on to even up the surface, and not to have it show the color of the filler, or make an opaque covering which will hide the color of the wood. The beauty of tone in graining and glazing is

in having the ground-work show through the graining color, or glazing modified by the rich tones of the color in the graining color or glazing used. The same rule applies to staining, otherwise the work may just as well be given a solid color.

The stain is applied with a sponge or large brush, the wood having been previously well rubbed with glass paper, and the dust thus made having been carefully removed. The stain should be sparingly applied, and should be well rubbed in, the desired depth of color being obtained by repeated application rather than by a dark and heavy one; for the wood if saturated with the watery mixture is liable to retain some of the moisture, although it may appear dry externally, and warping or twisting may result; and further the natural grain of the wood is better brought out by two or three transparent washes than by a single dark and opaque one. Several excellent stains may be purchased ready for use, but in case these cannot be obtained a few receipts for making stains are here given.

Blue Stains.

1. A beautiful blue stain is obtained by gradually stirring ½ oz. finely powdered indigo into 4 ozs. sulphuric acid of 60 per cent., and exposing this mixture to a temperature of 77° F. for 12 hours. The mass is then poured into 6 quarts of rain water and filtered through felt. This filtered liquid is several times applied to the wood until the desired color has been obtained. The more the solution is diluted with water, the lighter will be the color.

2. Indigo solution, or a concentrated hot solution of blue vitriol, followed by the application of a solution of washing soda.

3. Dissolve 1 oz. of best indigo carmine in ½ pint of water and repeatedly apply the solution to the wood.

4. Brush the wood over with a strong, hot solution of nitrate of copper in water, and then go over it with a hot solution of carbonate of soda, 2 ozs. to 1 pint of water.

Cherry stain.

Boil 4 ozs. of annatto in 3 quarts of clean rain water in a brass or copper kettle until the color of the annatto is imparted to the water. Then add ½ oz. of potash and keep the mixture hot for 30 minutes longer. When then cool enough to handle, it is ready for use. To make this into an oil stain, boil the stain down, after the potash has been added, to three pints, and then add 3 pints of boiled oil.

Ebony Stains.

Digest nutgalls in acetate of tin and rub this liquid well into the wood, and then polish it when dry.

Most of the dyes for staining wood a black color require to be applied very hot so as to penetrate the fibre of the wood, but enamel blacks can be laid on like paint or rubbed in like polish. The following formula belongs to the latter class:

Mix lamp black with French polish, and then use the mixture in the same manner as ordinary polish is used.

For a dye that is to be used warm, soft woods easily take the stain, but hard woods require either to be warmed or else the decoction applied hot.

Boil 8¾ ozs. nutgalls and 37 ozs. logwood in a quart of soft water for one hour in a copper vessel. Filter the decoction and apply warm.

To prepare a superior ebony stain for pear or walnut wood, boil 40 parts of gallnuts, 4 of rasped logwood and 5 each of sulphate of iron and verdigris with water. Strain this mixture through linen, apply the warm fluid to the wood, and then give it four coats of warm solution of iron filings in 75 parts of vinegar.

A common black dye for wood is prepared by dissolving $\frac{1}{2}$ oz. of extract of logwood in 36 ozs. of hot water and when the solution has cooled, but is not quite cold, add $\frac{1}{3}$ oz. of potassium chromate. Strain the mixture and repeatedly apply it to the wood until a dark brown color is obtained. This brown is converted into a black by using a wash composed of iron filings, the depth of the black being increased by the number of coatings of the latter fluid laid on.

The following formula gives good results: Boil 1 lb. of logwood in 1 gallon of water; while boiling put in two handfuls of walnut peel or shells, allow the boiling to continue for a little while, scoop out the logwood chips and pour in 1 pint of vinegar. Use the decoction boiling hot.

Boil over a slow fire 1 gallon of vinegar, 4 ozs. of Paris blue, 2 ozs. of nutgalls, and 2 lbs. of extract of logwood, and then put in a half-pint measure of ferric oxide. Use the stain while warm.

To produce a polish on ebony or black stained wood, give the wood one or two coats of fine copal varnish, and when this is dry rub it down smooth with pumice stone; then put on a second coat of varnish, and rub this down with rottenstone. Cleanse and put on a flowing coat of best spirit copal varnish, and when this has become dry, polish with chamois leather and the palm of the hand.

Mahogany Stains.

For mahogany stain for light woods, make a strong stain of red sanders by steeping it in alcohol, and mix it with asphaltum stain, which may be done by stirring a little oil of turpentine into the red sanders. Go over the work with this stain, using either a brush or rag as may be the most convenient, and repeat the operation until the desired shade is obtained. Put in the dark veins with clear asphaltum stain, using a small bristle brush.

Introduce into a bottle alkanet root 15 parts, aloes 30, powdered dragon's blood 30, and 95 per cent. alcohol 500. Close the bottle with a piece of bladder and keep it in a warm place for 3 or 4 days, shaking it occasionally; then filter the liquid. The wood is first mordanted with citric acid and allowed to dry. The veins may be imitated by the skillful application of acetate of iron.

A cheaper preparation is as follows: Boil madder 8 ozs. and logwood 2 ozs. with 1 gallon of water for one hour. Filter the decoction while still warm and apply the liquor to the wood. When dry apply a solution of pearl ash, two drachms to the quart.

For a *light mahogany stain* dissolve 2 ozs. of dragon's blood in 1 quart of oil of turpentine, keeping the vessel in a warm place and frequently shaking it. When solution is complete apply the mixture to the work.

The following process is recommended by Wiederhold: The coarse wood is first coated with a colored size, which is prepared by thoroughly mixing up, in a warm solution, 1 part of ordinary glue in 6 of water, a sufficient quantity of the commercial mahogany brown, which is in reality an iron oxide and in color stands between the so-called English red and iron ox-

ide. This is best effected by adding in excess a sufficient quantity of the dry color to the warm solution of glue, and thoroughly mixing the mass by means of a brush until a uniform paste is obtained in which no more dry red particles are seen. A trial coat is then laid upon a piece of wood. If it is desired to give a light mahogany color to the work, it is only necessary to add less, and for a darker color more, of the brown body color. When the coat is dry, it may be tested, by rubbing with the fingers, whether the color easily separates or not. In the former case more glue must be added until the dry trial coat no longer perceptibly rubs off with the hands. Having ascertained in this way the right condition of the size-color with respect to tint and strength, it is then warmed slightly and worked through a hair sieve by means of a brush. After this it is rubbed upon the wood surface with the brush, which has been carefully washed. It is not necessary to keep the color warm during the painting. Should it become thick by gelatinizing, it may be laid on the wood with the brush, and dries more rapidly than when too thin. If the wood is porous and absorbs much color, a second coat may be laid on the first when dry, which will in all cases be sufficient. On drying the size-color appears dull and unsightly, but the following coat immediately changes the appearance of the surface. This coat is spirit varnish. For its production 3 parts 90 per cent. alcohol are added to 1 part of red acaroid resin in one vessel, and in another 40 parts of 80 per cent. alcohol to 10 parts of shellac. By repeated agitation for 3 or 4 days, the spirit dissolves the resin completely. The shellac solution is then carefully poured from the sediment, or better still, filtered through a cloth. It may show a

slight milky turbidity, which, however, is no detriment to its use. The resin solution is best filtered into the shellac solution by pouring through a funnel loosely packed with wadding. When filtered the solutions of both resins are mixed by agitating the vessel and letting the varnish stand a few days. The acaroid resin colors the shellac and imparts to it at the same time the degree of suppleness usually obtained by the addition of Venice turpentine or linseed oil. If the varnish is to be employed as a coat, the upper layers are poured off at once from the vessel. One or two coats suffice, as a rule, to give the wood an exceedingly pleasing effect. The coats dry very quickly, and care must be taken not to apply the second coat until the first is completely dry.

Oak Stains.

Mix powdered ochre, Venetian red and umber, in size in proportions to suit; or a richer stain may be made with raw sienna, burnt sienna, and Vandyke brown. A light yellow stain of raw sienna alone is very effective.

An excellent oak stain is made by mixing 2 ozs. of American potash and 2 ozs. of pearl-ash in 1 quart of water. Should the color be darker than required, it may be diluted with water. It must be used very carefully, as the potash will blister the hands if allowed to touch them. The mixture should also be laid on with a very common brush, as it softens the hair so as to render it of very little value afterwards.

A good brown oak stain is produced by preparing the wood with a solution of 1 oz. of catechu boiled in 1½ pints of water. When dry brush over a solution of bichromate of potash, 1 oz. to 1½ pints of water.

Red Stains.

1. Boil 1 lb. of Brazil wood in 1 gallon of water for three hours or more ; add 1 oz. of pearl ash and apply the decoction to the wood whilst hot. Then brush over a solution of 2 ozs. of alum in 1 quart of water.

2. A decoction of archil forms a very good red stain for common work. Two or three washes of it should be given, after which it should be brushed over with a hot solution of pearl-ash and water.

Rosewood Stains.

Boil ½ lb. of logwood in 3 pints of water until the decoction is of a dark red color, then add ½ oz. of tartar. Apply three or four coats of this liquid, which must be boiling hot, to the wood, allowing each coat to dry thoroughly before laying on another. Veins may be formed in this with black stain, using grainer's combs or other implements.

Immerse ¼ lb. red sanders wood and ½ lb. of potash in 1 gallon of hot water. When the color of the wood is extracted, 2½ lbs. of gum-shellac are to be added, and dissolved over a quick fire. The mixture may then be used over the stain above described.

Bring alcohol 1 gallon, and camwood 2 ozs., into a bottle, and let stand in a warm place for 24 hours. Then add 3 ozs. of extract of logwood and 1 oz. of nitric acid. When all is dissolved the stain is ready for use.

Walnut Stains.

Vandyke brown (dry) 5 ozs.; bichromate of potash, ½ oz.; washing soda, 3 ozs.; water, 2 quarts.

Boil ten or fifteen minutes, and put it on, either hot or cold, with a brush. Let the work get thoroughly dry before oiling or varnishing.

Boiled linseed oil, 1 oz.; gum asphaltum, 1 oz.; turpentine, 4 ozs.; and a little Venetian red to give it the warm tone.

This answers very well for any soft wood if put on evenly.

Light Walnut. Dissolve potassium permanganate 1 part, in pure water 30 parts, and apply the solution twice in succession after an interval of 5 minutes. Wash with clean water, and when dry, oil and polish.

The same formula may be used for dark walnut, but after washing with water the dark veins are made more prominent with a solution of iron acetate.

Another walnut stain is made by mixing ¼ lb. of dry burnt umber with one quart of hot vinegar. Put it on with a brush, let it dry, then oil or varnish as desired.

On white wood or poplar, a strong solution in water of the extract of walnut peel makes a good stain. Coat the work over once or twice, according to the shade wanted, then when half dry go over it with a solution of bichromate of potash made by dissolving 1 oz. of the potash in 6 ozs. of water. When dry, finish as desired.

Practical Experiments in Producing New Colors upon Wood with Known Coloring Matter.

The coloring matters used are, according to their nature, either concentrated decoctions or solutions. To produce the desired color the stained wood is treated with the respective chemical agent.

Decoction of logwood treated with:

	Gives:
Concentrated hydrochloric acid . .	Reddish yellow.
Dilute hydrochloric acid	Reddish.

Concentrated and dilute nitric acid.	Red.
Concentrated sulphuric acid	Black.
Dilute sulphuric acid	Red.
Sulphide of hydrogen	Yellow-brown.
Ferric nitrate	Black.
Potassium chromate	Black.
Stannous chloride	Violet.
Tartaric acid	Gray-brown.
Sulphate of copper	Dark gray.
Tannin	Yellow red.
Sal ammoniac	Yellow.
Verdigris	Dark brown.
Sugar of lead	Gray-brown.
Potash	Dark red.
Potassium permanganate	Light brown.
Potassium iodide	Red-yellow.
Cupric chloride	Reddish violet to dark brown.
Chrome yellow	Dark violet.
Soda	Violet.
Sulphate of iron	Gray to black.
Alum	Dark red-brown.
Carbonate of potash	Yellow-brown.
Magnesium sulphate	Brown.
Cupric nitrate	Violet.
Aqua ammoniæ	Dark violet.
Potassium sulphocyanide	Red.
Zinc chloride	Red-brown.

Decoction of Fustic extract treated with:

	Gives:
Concentrated hydrochloric acid . .	Red.
Dilute hydrochloric acid	Yellow-brown.
Concentrated nitric acid	Reddish-yellow.

Dilute nitric acid	Brown.
Concentrated sulphuric acid	Dark purple.
Dilute sulphuric acid	Brown-red.
Aqua ammoniæ	Dark yellow.
Ammonium sulphydrate	Dark yellow.
Ferric nitrate	Dark gray-yellow.
Tannin	Yellow.
Potash	Yellow.
Stannous chloride	Yellow.
Cupric chloride	Yellow.
Tartaric acid	Yellow.
Alum	Yellow.
Pyrogallic acid	Yellow.
Cupric sulphate	Orange.
Sugar of lead	Yellow.
Potassium permanganate	Brownish-yellow.

Decoction of Brazil wood extract treated with:

	Gives:
Concentrated nitric acid	Dark purple.
Dilute nitric acid	Pale red.
Concentrated sulphuric acid	Red.
Dilute sulphuric acid	Purple.
Concentrated hydrochloric acid	Dark red.
Dilute hydrochloric acid	Light red.
Aqua ammoniæ	Dark red.
Ammonium sulphydrate	Dark red.
Sulphide of hydrogen	Light red.
Sulphate of iron	Dark violet.
Tannin	No change.
Stannous chloride	Light red.
Cupric chloride	Dark red.
Sal ammoniac	Reddish yellow.
Sugar of lead	Yellowish red.

Potash	Dark crimson.
Tartaric acid	Reddish yellow.

Decoction of madder treated with:

	Gives:
Dilute hydrochloric, sulphuric or nitric acid	Pale yellow.
Sugar of lead	Reddish violet.
Soda	Red.
Tartaric acid	Pale yellow.
Tannin	Pale yellow.
Potash	Light red.
Sal ammoniac	Pale yellow.
Aqua ammoniæ	Reddish yellow.
Alum	Faint red.
Stannous chloride	Light red.

Decoction of French berries treated with:

	Gives:
Dilute hydrochloric acid	Rose color.
Dilute nitric acid	No change.
Dilute sulphuric acid	Yellow.
Potash	Yellow.
Stannous chloride	Dark yellow.
Tartaric acid	Discoloration.
Sugar of lead	Dark yellow.
Ammonium sulphydrate	Faint yellow.
Potassium bichromate	Brown-yellow.
Ferric nitrate	Dark olive green.
Potassium iodide	Yellow.
Cupric sulphate	Greenish-yellow.

Decoction of turmeric treated with:

	Gives:
Hydrochloric, nitric or sulphuric acid	Yellow.

Sulphate of iron	Greenish-yellow.
Ferric nitrate	Yellow to dark yellow.
Sugar of lead	Yellow.
Alum	Yellow.
Potash	Red-yellow.
Stannous chloride	Yellow.
Sodium	Yellow.

INSTRUCTIONS FOR SIGN-WRITING.

SIGN-WRITING is a mere mechanical art; any person with a common stock of perseverance may acquire it. The writer is bound down to certain set forms, and to a constant repetition of those forms; there is nothing left for the exercise of genius or taste, but the arrangement or setting out and choice of colours.

The pupil's first object must be to acquire a thorough practical knowledge of the forms of letters now in common use, such as manuscript or text-hand, Roman capitals, italics, Egyptian, block, &c. &c. The best models for this purpose are placards in bold type; if good, they are generally proportionate, and have all the modern improvements. To become a good sign-writer, you must first practise the manuscript or text-hand; by doing so you will acquire the habit of making a free and graceful stroke, or sweep with the pencil, which will be very serviceable to you when you practise the Roman capital, which you should do next. When you have mastered these, the others will be comparatively easy. Many learners begin with the plain Egyptian block, for the simple reason that it is the easiest. They never make good writers, from the fact that by doing so they acquire a stiffness in the use of the pencil, and formation of the letters, which they very rarely, if ever,

get rid of For practising, you will require a smooth board about three feet square, painted a light colour. Secondly, a stick, with a ball of cotton wool covered with wash-leather, and tied over one end of the stick : this is to prevent it injuring the paint when you rest it against it Thirdly, a small palette-board and palette-knife. Fourthly, a few good sable and camel-hair pencils. When purchasing the pencils, dip them into a tumbler of water, and try them on a piece of paper: if they retain a fine point they are good; if not they are not worth having. Fifthly, a pennyworth of unburnt pipe-stumps, which you will get at any pipe-maker's. Sixth, a two-foot rule. Seventh, a pair of compasses.

Now set out your board as follows :—Take your rule, or compasses, and divide the board into equal parts with horizontal lines, leaving say three inches for the size of the letters, and two inches for the space between each line of letters. Use a piece of pipe-chalk, and slightly sketch your letters with it; then mix vegetable black with boiled oil to a proper consistency for working; with this, and a fine pencil, endeavour to form the letters. Use the point of the pencil in all cases, and strive all you can to form the letter in outline with as few strokes as possible, filling up between the lines with a short pencil. By following this principle you will acquire ease, rapidity of execution, and correctness of outline. Practise this method constantly, and you will become a good writer. Before your black is dry, wash it off with turpentine, then with soap and water: this will clean your board ready for practising again.

Setting-out or Arrangement of Letters.

This is a very important part of sign-writing; for, however good the shape of the letters may be, if they are not properly arranged the effect will be bad. By strict attention to the following rules, you will soon be able to set out a sign properly:—

1. It is always desirable to introduce into a sign a curved line, or section of a circle, as it is pleasing to the eye, and relieves the stiffness of the straight lines.

2. The space between each letter in the same line must be equal.

3. Each line of letters must begin and end at an equal distance from the side of the board.

4. Never, if you can possibly avoid it, begin or end a line of letters with such letters as "and—to—for—with," &c.; but let them come in between the lines of larger letters.

5. Always make the most important words, such as the name, business, &c., the largest, most distinct, and easily read of any on the board. You will see exactly what I mean if you examine a good placard. It is only by strict attention to the above rules, and constant practice, that you can become a good writer.

To raise or make Letters appear to stand out from the Board, and to shadow them.

For this purpose you require a knowledge of light and shade; to acquire that knowledge, as far as regards letters, I would advise you to get a few good letters cut out of wood, say an inch thick; fasten these on a painted

board; place them in a position where a side light will fall strongly upon them: they will exhibit to you their true principle of light and shade. Study them well in all positions; they will be your best guide.

To gild Letters.

You will require a gilder's tip-cushion and knife, or you can lay on the gold from the book, by cutting the leaves to the size you want with a pair of scissors. You may use either oil or japanner's gold size; oil-size is the best, and is made in the following manner:—Procure some old or fat linseed-oil; the older it is the better. Mix a little Oxford ochre with it, and a small quantity of sugar of lead; thin it with boiled oil; now strain it through a piece of fine linen. Prepare your board as smoothly as possible; take the white of an egg, beat it up in about four times its weight of cold water; add a small quantity of fuller's earth; brush over the board with it; this is to prevent the gold sticking to any part but the letters. When dry, set out the letters and commence writing; a sable pencil is the best for laying on the size. Always remember that, to make your gold bright, you must use as little size as possible, consistent with covering the letters properly; let it stand until you can barely feel a slight tack or stickiness. If the size is good it will gild in a week after it is written. Your letters being ready, put some gold into your cushion, which you will do in this way:—Carefully open, and with a slight puff with your mouth blow the leaf of gold into the back part of the cushion; now take a leaf up on the point of your knife, and spread it on the front part

13

of the cushion; when you have got it partially straight, give it a slight puff with your breath, which will make it perfectly so. Cut it to the sizes you want, using the heel of your knife, and cutting forward. You will find this very difficult at first; but persevere, and you will soon do it with ease, and without waste. Now take the tip, rub it lightly on your hair or whiskers, take up the gold on the point and place it gently on the letters; when you have covered them all, get some very fine cotton wool, entirely free from grit; with this gently rub the gold until it appears smooth, bright, and level. Now wash the sign with plenty of clean water, to clear off the egg-size.

To Write, Gild, and Ornament on Glass.

Before you commence this work you must acquire a thorough knowledge of sign-writing, otherwise it will be folly to attempt it. You will require a drawing on paper for each design, which you will prepare as follows:—Cut a piece of thin paper to the size of your glass, draw out your design correctly in black lead-pencil on the paper, then prick through the outline of the letters with a fine needle. Tie up a little dry white lead in a piece of rag; this is a pounce-bag. Now place your design upon the glass right side up, and dust it with the pounce-bag; take the paper carefully off, the design will appear in white dots upon the glass; this is to guide you in laying on the gold on the opposite side. Now clean the glass well on the side that the gold is to go on; prepare your size in the following manner:—Get some perfectly clean water, without the slightest

particle of grease or other foreign matter; put it on a slow fire to boil, using an enamelled saucepan for that purpose, and taking particular care that the smoke does not get into it; while boiling, put in two or three shreds of the very best isinglass; let it boil a few minutes, then strain it through a fine clean linen rag; when cool it is ready for use. The great point in glass-gilding is to have the glass, the size, and every thing you use perfectly clean; a touch of the finger on the glass will tarnish the gold; you must use the tip and cushion to put on the gold, laying the gold on as level as possible, as its uniform brightness depends in a great measure upon that point; use a flat camel-hair tool for laying on the size; flow the size on, and let it drain off when you put the gold on; when perfectly dry, take a ball of the finest cotton wool, and gently rub or polish the gold; you can then lay on another coat of gold if desirable; it is now ready for writing. As the letters will have to be written the backward way, you must turn your drawing face side downwards, and pounce as before; but on the gold this time mix a little of the best vegetable black with black japan; thin with turpentine to a proper working consistency; write with this when thoroughly dry; wash off the superfluous gold, and shade as in sign-writing. In ornaments you will have to etch, or shade the gold: you will proceed to lay on the gold and pounce the ornament exactly as above; then etch or shade it with the point of a slate-pencil, or piece of hard wood, slightly wetting the wood, when you want a broad or black line; then pick in with black.

COMPLETE INSTRUCTIONS FOR COACH-PAINTING AND VARNISHING

A SUITABLE place to do work in is an important consideration in painting, but as workmen will have opinions of their own about making things convenient, I will not take time to go into details about conveniences in constructing shops or paint rooms; only this I will say to the uninitiated: you must have a room where you can exclude dust entirely, and means for ventilating the room whenever you wish. These qualifications are indispensable.

The first thing that presents itself is the mode of preparing the oil used in painting, and, as this is a disputed point, and a very important one, I will give such reasons for my opinion as have been gathered from thirty years' practical experience in the trade. Those who learned their trade thirty years ago were taught to use boiled oil in carriage-painting, and we are not apt to forsake our early teachings without convincing proofs of their fallacy. I have, by experience, been driven from my good opinion of boiled oil in almost every department of painting. Its supposed advantages are that it dries quicker and flows over the surface of the wood better than raw oil. Its positive disadvantages are that it is more brittle

when dry; if bruised, will break from the wood, and unless the utmost pains are taken to get it thoroughly dry, the varnish that is put over it will crack after it has been exposed to the sun. We are deceived about its drying quicker, and that is the cause why paint and varnish crack. Boiled oil gets its drying quality from the oxygen which it imbibes by heating, and the oxyds of lead which are put into it while boiling. There is no visible part of the lead used for dryer left in the oil when it is ready for use, therefore I suppose the oxyd which it absorbs from the lead is the dryer—be that as it may, there is one thing certain, we know oil so prepared will not dry unless it comes in contact with the air. Corked in a bottle, it will never dry, and this is one great difficulty in using boiled oil. Suppose we have painted a piece of wood with one coat and got it thoroughly dry, the air, oil, or turpentine cannot go through the coat of paint when the second coat is applied. The part of the second coat which is exposed to the air dries on the outside, forming a skin which prevents the air from getting to the drying quality of the inner part, and shuts it up almost as close as if it were corked up. The air being so penetrating will, after a long time, get to it and dry it; but it takes a long time, unless the paint with which it is mixed can impart to it a drying quality independent of the atmosphere. Painters who use boiled oil obviate this difficulty by mixing a large proportion of turpentine with the oil or paint, making what they call a dead coat—this, when the turpentine has evaporated, dries without a gloss, and leaves the paint open like a sponge, so that the air can get to the oil. Experience proves this to be the poorest kind of paint to last—if bruised, it breaks off

clear to the wood; if left to time it comes off very soon in small scales—yet there is a great quantity of work done in this way, because the paint can be rubbed down smooth with sandpaper easier than if it were of a tougher material. Before I get through, I hope to show that paint can be made smoother and as tough as you wish without using much sandpaper, and with less labor. Boiled oil will not bear much japan for a dryer. If too much is used the paint comes off in large scales, and leaves the carriage in the very worst condition for repainting.

Raw oil dries with less gloss, leaving a chance for the air to penetrate the paint as well as the dead color, and, aside from that, the dryer used in the paint dries more independent of the action of the atmosphere. For instance, I have seen red lead ground in oil and soldered up in tin cans so as to entirely exclude the air, and in one year the paint would become a hard cement. Boiled oil, under the same circumstances, would never dry without the red lead.

A ship-painter will never use boiled oil about any part of the vessel that is exposed to jamming by the dock, because the paint will break off clean to the wood. For these reasons I should use raw in preference to boiled oil, with but very few cases excepted.

To prepare raw oil for use, it will be necessary to add one-fifth part of good brown japan to four of oil. If paint requires any further dryer, equal parts of sugar of lead and white vitriol ground together can be used, to the amount of one ounce to the pound of paint, or the same amount of patent dryer.

For the priming coat of a carriage-gearing and body

use the same kind of paint, to wit: white lead mixed in the above prepared raw oil, and about one eighth part turpentine, with a shade of lampblack, if your carriage is to be a dark color. When the wood-work of a carriage comes into the shop, examine it closely, and if the grain has raised in any place, or it wants smoothing with sandpaper, be sure and do it before you prime the work, then dust it off and put on the priming coat even, and be sure to have the paint go into the cracks, checks, or screw-heads, so that they have at least one coat of paint over the surface which is to be puttied up.

The carriage-part wants but one coat before it is ironed, but the body you will retain in the shop while the gearing is being ironed. After it has had four days' drying, and has been sandpapered off, give another coat of the same kind of paint with a little dryer, and about one fourth as much turpentine as oil.

The object now is to get a perfectly even surface on the work of the body, which cannot be done on the bare wood, on account of the grain of the timber. For this purpose a heavy coat of coarse paint, prepared so that it will dry as hard as a bone, is put on, and, after it is dry, is rubbed with a flat surface of pumice-stone in water, which rubs the paint off from the ridges down even with the hollows, thereby making the surface level and smooth. To facilitate this operation I have adopted something different from the old way, which is better and easier. I have some fine-grained sole leather cut into pieces so that I can have three different ones, with a straight-edge of from one to three inches in width, these edges are made rounding and smooth with sandpaper.

After the turpentine has evaporated from this second coat which we have put on, and before it is dry, I take one of these leathers in my fingers very much as I would a scraper, and draw the edge over the soft paint. This crowds the paint from off the ridges down into the hollows, and levels it quicker and better than two coats of "rough-stuff" will. The parts which are not going to be rough stuffed, such as the spindles to the seat, or any such small place, I rub over with my hand and fingers, so that I get the paint crowded into the grains of the wood, and all the brush marks are removed. After repeating this process the second time on the seat and part which is not to be rough-stuffed, it will be ready for putting on the color. I make my putty of whiting and good drying varnish; and when the paint has got dry on the body, the screw-heads, and other places where the rough-stuffing is to be put on, should be filled up more than level, and the surplus will be cut off with the rough-stuff.

Now the body is ready for the rough-stuffing, which should be made of about seven parts of yellow ochre to one of white lead, mixed in four parts of good drying varnish and one of brown japan, and about one fifteenth as much raw oil as you have of copal varnish and japan together.

This mixture should be stirred together as thick as it can be conveniently run through the mill. It is not best to grind it fine; but as near the same fineness as can be. After it has been run through the mill, reduce it with turpentine, so that it will work easy under the brush, and apply a good coat to the part of the body that has a large surface, so that you can get at it with a

pumice-stone to level it down. It will take five or six days for a coat to dry so that you can apply the next, and, as a general thing, three coats of rough-stuff will be sufficient for a carriage-body. Sometimes one coat will answer for a buggy; it depends, in a great measure, on the skilfulness of the wood-workman in getting a level and smooth surface on his job.

If he leaves hollows, there must be enough applied to fill them up even with the more prominent parts of the surface. After the body has got sufficient rough-stuffing on, it had better go to the smith, to be ironed and hung on the carriage. When it comes to the paint-shop again, the first thing will be to rub it down, so that you have a smooth and even surface, free from all dents, grains of the wood, tool-marks, or any thing in the way of making a good, even surface, to put the finishing coat of paint on. This operation does not require any very great amount of genius, but there cannot be too much care bestowed on it. Saw the pumice-stone into blocks of a suitable size, and have by you a small, round file, so that you can shape the stone to fit the mouldings, if necessary; and a pail of water and sponge, to wet the work with and wash it off, while rubbing it down. Now wet the work with the sponge, and with a wet block of stone commence rubbing the part until it is smooth and level, rubbing carefully into the corners and close to the mouldings, so that every part is equally level and smooth. You will have to use the sponge frequently, to clean the paint and see if you are not rubbing through to the wood, or have got it rubbed enough. When the brush-marks are all rubbed out of your rough-stuffing, it will, as a general thing, be rubbed enough. There are often

places found, after rubbing down, where there is a dent in the wood, so that the pumice-stone has not cut out the brush-marks. To remedy such places, take the putty that you have filled up the screw-heads with, and, if it is not soft enough, add a little varnish, so as to make it soft enough to spread under the putty-knife; then fill the hollow places more than even full, and after it has become dry, which will be in three or four days, rub it off with the pumice-stone, so that the surface is level and smooth. In rubbing down, if the stone scratches, or makes creases in the paint, or gums on the stone, the paint is not dry enough, and should be left to dry until it gets so hard that it will not scratch. If, by mistake, you have rubbed through the paint, and wet the wood so as to raise the grain, when it gets dry rub off the raised grain with sandpaper, and put on the spot a coat of rough-stuffing, and when it is dry use a little linseed oil, instead of water, with the pumice-stone, which will not raise the grain of the wood, and, when it is rubbed off smooth, wipe the oil off with a rag, and clean the body off with a sponge and water, and it is ready for the color.

It will be better now to commence the carriage part, and, in finishing that up so as to receive the color, I have adopted a different way from any that I ever have seen laid down, or in any way been taught; yet there are others who practice the same plan and keep it a secret. The old way is to mix the paint with enough turpentine to make it brittle when dry, then scour out the brush-marks with sandpaper. This rubs off nearly or quite one half the paint, and, aside from that, the turpentine evaporates and does not leave enough oil in the paint to resist the action of the atmosphere and protect the wood.

Also, sandpapering off the poisonous paint and inhaling the dust is one cause of the unhealthiness of the trade. The way I have adopted does away with these difficulties, and is much quicker done, and makes a handsomer finished job. Commence the carriage part by sandpapering off just enough to remove the specks that may have fallen on the paint.

If you are going to paint the carriage with any color which of itself will be a body, it will be well to prepare the paint of the color that you are going to finish with, unless the paint is too expensive to use for a body-coat; and, if so, you should use the paint that is the nearest to it in color and at the same time has sufficient body—for instance, for vermilion use red lead and Venetian red on the body or priming coat. White lead and lampblack, mixed so that it is a slate color, is a very good paint to give a body for any dark-colored finish. Mix the oil—which is prepared with one fifth japan—with one fourth as much turpentine; and when you want to reduce the paint, do it with this mixture, so that the paint will be alike in turpentine dryer. Dust off the work clean, and put on a coat of paint that is well ground, and perfectly clean from all skins, dirt, or specks of any kind.

After the paint has stood a while, so that the turpentine has evaporated, commence by rubbing it with the palm of your hand and fingers, so that you obliterate all your brush-marks, and fill up the coarse grains to the timber by crowding the paint into them. Use a leather in corners where you cannot smooth with the hand, and use the leather on the springs, or any other flat surface, and then brush it over with the hand. In this way the work is very easily brought down to a smooth, polished surface.

After the second priming-coat has become dry, you can putty up all imperfect joints or checks, and all places where the iron does not fit to the wood closely on the felly, or any other part. After this coat of paint is well dried, sandpaper it off as before, just enough to remove the specks which may have fallen on while the paint was drying; and if you discover any place in the corners where you have not smoothed it down with the hand, it will be best to smooth it with sandpaper, and then apply another coat, and go through the same process of rubbing down with your hand. Three coats will be enough in this way to give sufficient body for the color. It will fill the grain of the timber so that it cannot be seen, and make a smoother and better coat than any other way I have tried. I think it saves full twenty-five per cent. in painting a carriage.

You will now want to put on two coats of color to finish with, and you will observe the same process about smoothing it down. Also, remember that what makes paint and varnish crack after it has become dry, is, that it was not perfectly dried when the coats were being put on.

While the carriage has been painting, the irons on the body, and all places where you do not use rough-stuffing, should be worked with the same paint in the same way that the carriage has been; so that the wood gets three and the irons two coats of paint, and then the body is ready for the color.

The color should be ground fine; and perhaps you will find it better to use more turpentine in the paint than you have for the carriage part. You need a room that is clean, and where no dust will be raised while the paint

is drying, and you must have a soft, flat brush (called camel's-hair), about two and a half inches wide, and those are best when the brush-part is only about one and a half inch long. Examine well to see that there are no loose hairs in it that will come out while painting. The surface of the body is now smooth and level, and the object is to get two coats of paint on for finishing, without leaving brush-marks, or any thing to destroy this smooth, level surface; therefore be sure and have your paint mixed so that it will run off from the brush easy, and be spread without bearing hard on the brush. It is best to try the paint before you commence laying it on the body, and when you are sure it will work easy, lay it on the body as briskly as you can, and do it well, finishing it up with light brushing. After it has got dry enough for the second coat, rub it over with curled hair, so that it takes off all the specks; and it will have a tendency to flatten down the brush-marks which are hardly perceptible. One more coat in the same way finishes the body, ready for striping.

After putting on the second coat of color, and it has become sufficiently dry, take curled hair and rub it enough so as to flatten down any brush marks which your fine brush may have made. This will be a sufficient body for a medium good job, providing care has been taken to mix the paint according to the directions, and you have had no bad luck in putting it on. If you wish to have an extra good job, you must add more coats of the color, or finishing coats, being sure to give it time to dry, so that you have body enough to smooth it down and take out the brush marks with rotten-stone. This rubbing-down is done with pulverized rotten-stone,

laid on a wet woollen rag, or felt, and then rubbed on the painted body until you have polished off all the brush marks. The most that there is about this operation is —carefulness not to rub too much in one place so as to rub through the color, and, at the same time, polish over every part evenly, so that it is as smooth as a mirror. If, by accident, you have rubbed through the paint, it sometimes can be remedied by putting on the injured spot a little more of the color with a soft brush; but this kind of patching cannot be carried on to any very great extent on a first class job. While you are rubbing down the paint, use a sponge and water frequently, and wash it off so that you know just how much it has been rubbed.

After the body has been thoroughly polished, wash it well with water, until you have removed every particle of the rotten-stone. All this requires the utmost care, and the workman should not have any other business on his mind to divert his attention from his work. Having got a sufficient coat of paint on the body, the next thing will be to prepare it for ornamenting. Painters differ about this. Some stripe on the paint, and others put on a coat of varnish and stripe on that. I prefer the last way, because the striping runs on to the varnish easier than on the paint; therefore, I should put on a coat of good varnish—and by good, I mean the very best American to be had—for that is the cheapest for the workman, in order to produce the same effect in looks.

For varnishing, it is absolutely necessary to have the room free from dust; and it must be kept at a temperature about as warm as a workman can comfortably bear to work in. If you are not sure that your varnish is free

from specks, it will be better to filter it through cotton factory cloth; sometimes there are small particles of gum in the varnish, which are transparent, so that you cannot see them until after the varnish has been laid on to the work, when they show themselves in small specks which we sometimes take for specks worked out of the brush. Lay on the varnishes with a good fine bristle brush, even and with straight brush marks, drawn very lightly for the finish. Sometimes, on a very smooth finished job, the varnish will dry leaving little pit-marks, where the varnish seems to crawl off from the paint, making it look as though it had had the small-pox. I believe this is a defect in the varnish, and I never saw it do so but once; yet a painter, who had used a large quantity from the same lot of varnish, told me that it was a frequent occurrence with him. It is a frequent occurrence for striping and varnish to crawl off from where it has been laid, and I think the preventive of the latter difficulty will answer for the former.

To prevent paint or varnish from crawling, take a flannel rag and rub it over the work previous to varnishing, striping, or painting; this will prevent any difficulty about its crawling. Of a great many ways for preventing paint or varnish from crawling, which I have seen practiced, this, I think, is far the best and cheapest. In varnishing, always be careful not to put the varnish on the corners of the work and leave it to run down. Always examine these places carefully before leaving the work; and, as a general thing, you must commence on the inside panels of a body, and work to the outer edge the last thing. Another general rule is, to commence the work that is the highest up first, and finish

that which is the lowest last; this prevents dirt from falling on and sticking to the paint while you are working on it. When the work is varnished, close the room tight and leave it to dry, without opening the doors or doing any thing to get dust on the work, until it gets so that it will not stick. After taking all these precautions to prevent specks, if you should still be unfortunate and get some on, they must be removed with fine sandpaper before the striping or ornamenting is commenced.

In ornamenting and striping a carriage, it requires considerable taste and judgment. If the painter takes hold of his work as an artist does the canvas, and tries to see how much of his skill he can display on the surface he has to work, he will be very likely not to please himself, or any one else. He should be contented, not particularly to show off his own skill, but to preserve and show in the most graceful manner the workmanship of the builder. If the builder has not got gracefulness in *his* work, then the painter has still to try, by striping, to give it that appearance. It is very often the case that we see good made to look like very ordinary work, merely from a bad taste in the striping, so that it does not preserve the gracefulness which the builder intended it to have, and no one seems to know exactly where the fault is, for he cannot point out any particular defect in the painting. On the other hand, I have seen very ill-shaped work, particularly in that kind called market wagons, or wagons of that grade, put into such shape by the painter, that no objection was made to their ill-proportions. There is a certain curved line which enters into the form of things having beauty and gracefulness, and if that line is wanting, there are but few who can

point out the particular defect, but every one knows there is something wrong.

In large panels of carriages, and particularly on the backs of sleighs, it is frequently necessary to put in a centre ornament, which relieves the large and clumsy look which it otherwise would have. This often gives painters a great deal of trouble, because they do not know how to get up an ornament; and yet the thing is very simple when understood, requiring no uncommon skill.

I will now give the process of putting the ornament on the panel of a carriage, as it will be necessary to do so before the body is striped, and I shall not revert to the subject again, although I expect the painter, without any very great stretch of ingenuity, will make the same process answer to paint landscapes on the inside of omnibuses, put borders on sleighs, or, in fact, do any kind of ornamenting.

After selecting an ornament, take a piece of thin transparent wrapping paper and oil it over with linseed oil until it has become saturated, then rub off all superfluous oil, and afterward lay the paper over any one of the ornaments which you may select, and with a lead pencil trace neatly all of the ornament, not leaving out any of the shades, just as it is in the engraving; then turn the paper over on to a piece of white paper, and on the other side trace the same engraving, which will appear very distinct on the other side of the oiled paper. The panel which you wish to put the ornament on must be dusted over lightly with whiting, if you intend to put any gilt in it, to prevent it from sticking to other parts of the work where it is not wanted; then have the panel

put into a horizontal position, and lay the side of the ornament which you draw last on to the place where you want it painted, and fasten it there by laying some small weight on the side of the paper from where you wish to work; then with your pencil trace over the lines again on all the design except where you intend to put the gold leaf. This part needs only to be traced on the outside of the design. The result of this operation will be that tracing the design over on the paint will crowd the pencil mark down on to the paint, and will stick as plainly as though it had been drawn there with the pencil. The side of the paper can be raised to see if you are working all the drawing on the panel; if you do not remove the weight the paper will fall back to its original place.

After the design is drawn on the panel, take some quick-drying varnish, and with a common sable artist's pencil, lay some varnish on the spot where the gilt is to be put, and after the varnish has got hard, and yet a little tack to it—which will be in an hour or two—then lay on the gilt, press it down on to the paint so as to have it adhere. Leave it for three or four hours, if you can conveniently; afterward rub it down with some soft buckskin, or a silk handkerchief, and then lay the design on to the gilt, which you can very plainly see to do, and with the pencil draw the shades the same as before on the gilt. This will give you the design of what you want to put on for an ornament so that you can see it very distinctly on any color, and all the painter will have to do will be to color and shade it up in a proper manner. For this ornamenting you want artists' sable hair pencils, from the smallest size up to four or five sizes above.

The shade, which seems the most appropriate for gilt, is a transparent brownish color, which is got by mixing burnt terra de sienna with black asphaltum, varnish, and enough of oil to keep it from drying too quickly.

Commence shading the gilt by putting on the deep shades as they are in the engraving. With the same paint lighten it by spreading the paint thinner on the gilt, as the parts which are to appear the most prominent must not be touched with the paint. The points of scrolls which turn over so as to show the other side, can be tipped with orange-colored paint, lightened up with white, or frequently with some other color which fancy dictates. The painted part of the ornament must be painted for the groundwork with the color directed, or as your own judgment may dictate. Shade with the same shades you have used on the gilt, or perhaps make a little more opaque by adding vandyke-brown, lightened up with white if the case requires.

A very tasty ornament can be made by putting the groundwork of any of these ornaments wholly of gilt, and shading according to the above directions. Those who expect to excel in ornamenting should have some knowledge of perspective, which can be had by consulting the Oxford drawing-book, or perhaps almost any other work on that subject; yet, to those who do not aspire any higher than to use ornaments that have already been engraved, the above process will be sufficient.

To arrange the colors in striping, there are a few rules that should always be observed: The darkest color should be on the outside. If a carriage body is to be of two colors, the outside mouldings should be a darker shade

than the panels. It is not considered in accordance with good taste to put much striping on a good body; as a general thing, one fine line is sufficient for a panel, but, if it is necessary to put on any more, the fine line must be nearest to the centre of the panel, or on the inside of the wider stripes.

There cannot be any precise rule laid down about mixing the paint and oil for striping, and yet it is one of the most important things to have the stripes run on the work easy. If there is too much dryer in the striping it curdles and will not flow over the place where it has been laid, and when it is dry the body paint can be seen through the striping. I practice using boiled oil for wide line striping, with one eighth turpentine, and for fine lines raw ôil without any turpentine, and just as little dryer as will suffice to make the striping dry in time. For both kinds be careful about working the paint too thick. Take time to get the striping so that it works easy, and you will save time before the job is done. Where there is but one line on a panel, it is better not to mark it with the dividers, but to trust to your eye to get it correct; but new beginners may have to mark the line until they get full command of the hand. Where there are two or more, it will always be necessary to run the dividers on one side of all the lines so as to keep them the same distances.

For a gilt stripe, which is necessary for coaches, sleighs, etc., it is better in my opinion to use varnish to lay the gilt with; and if the varnish dries too quickly, a little raw oil will correct that and make it more tacky. The difficulty in fat-oil for laying leaf is, that it often spreads over the edges of the stripe, and also, it has too much

body, making a ridge where the stripe is. It seldom looks well to see a stripe on a panel intersect another stripe at right angles in the corners, especially where there is but one line around the panels. Some shift is nearly always made to make the corners round or scalloping.

The carriage part can be striped more than the body; and small tasty scrolls, put into proper places, have very much the effect in filling up that an ornament has in the centre of a large panel; yet this part is often overdone with stripes. Great care should be taken to make the stripes true, and to preserve, as has before been said, the beauty of form in the carriage. Preserve the same style and colors as nearly as can be, with the body and carriage part.

I use what are called "camel's hair" pencils, and, perhaps from habit, cannot use any other kind for striping. Long sable hair pencils are more elastic and stiff, the hairs are straighter, and will keep so a longer time, and the pencil will last enough longer to nearly pay the odds in the price; and if the painter can work with them best, certainly there can be no objection to using them. I find as much difficulty in changing from the "camel's hair" to the sable hair brush, as in changing from the quill to the metallic pen. A pencil brush should be from one and a half to two inches long, and when not in use should be cleaned out with turpentine, dipped into lamp oil, and laid carefully away on a window-glass, in such a manner that the hair will keep perfectly straight; and when you want to use them, wash them out in turpentine and twirl them between your hands until they have thrown out all the lamp-oil and turpentine, and they will

be ready for use. We cannot find brushes in the stores small enough to make the fine lines. This can be remedied by cutting away some of the hair, or you can make small brushes from a large one, by taking a piece of rattan and making it round, about the size of a pencil handle, and splitting the end into quarters; then turn these split parts back and cut off the corners so that when they are turned back there will be a hollow; where the corners are cut out, put what hair you want into this hollow space from a larger pencil brush, and fasten it by winding a thread around the stick. Wet the string with glue, and you have a very good pencil.

After a carriage has been striped, it should have time to become sufficiently dry before varnishing, or there will be the same difficulty with its cracking, when put on over the striping, as is found in putting varnish on the body paint before it is sufficiently dry. This difficulty is often erroneously attributed to the inferior quality of the varnish, when in fact it is nothing more than the injudicious application of varnish before the paint has become sufficiently dry. In the application of varnish, a practice has become very common, and is also recommended by varnish dealers, of using different kinds over the same body of paint. For instance, they have what they call rubbing varnish, to be applied for the first coats, which will dry quick and hard, making a coat that can be polished down smooth with rottenstone, after which being done, they recommend putting a coat of wearing varnish that dries slow and flows over smoothly, giving a beautiful appearance to the job. Painters have worse practices among them occasionally than this; but, I must say, this is bad enough, as may

be plainly seen by investigating the subject for a moment. Take two kinds of varnishing, one with the foundation, or first coats, of this quick-drying varnish; the other, the foundation and finishing the same. of the slow-drying, wearing varnish, and when they have got thoroughly dry, test them by the force of resistance that they show to accidents to which they are liable, such as scratching or jamming. First, take the point of a pin and scratch it across the surface of the work that is finished with two different kinds of varnish—rubbing and wearing—and it will be seen that the point of the pin will make a ragged kind of a mark, four or five times the width of the pin point; then take a hammer and strike the same varnish, and it will be seen that the place hit will have a yellowish-white appearance, which is occasioned by the under or rubbing part of the varnish crumbling or breaking up.

Again, try the same process on the job that is done wholly with the wearing varnish, and it will be seen that the point of the pin will make a mark only the width of the point of the pin, leaving the edges of the mark straight and regular. The stroke of the hammer will be very much in effect like striking on a metallic surface; it may make a dent, but not crumble or give the varnish another color, unless it be a very violent blow. Scratching and bruising are two of the most common accidents varnish is liable to. If we take two carriages done in two different ways, by a skilful workman, we may. on the first appearance, pronounce in favor of the one that is polished smooth with the rubbing varnish; but put them in use together, and it will be observed that the one that at first so readily met with our appro-

bation, will meet with the first accident to its fine finish; and it will continue in the same way, always showing a mark for every bruise or scratch that it receives. On the other hand, the other one will appear as if it had been used in the most careful way, so that it had avoided all accidents, and in fact will preserve its finish much the longest.

The usual practice among American painters is to use American varnish for all the rubbing coats, and finish with a flowing coat of medium English, without polishing. The objection to using English in all cases is that it dries so slowly that it would take at least six months to paint and varnish a carriage with it, a process for which no customer would wait.

In order to varnish a carriage well, it is necessary that you be well acquainted with the peculiarities of the varnish, if it has any; and remember that it does not always insure a good job by putting on a great many coats, but that it is more likely the desired end will be attained by carefulness and good judgment. If it is cold weather, see that your varnish is made of about the same temperature as the room that you varnish in, which should be as warm as you can comfortably work in. The same may be observed with regard to the job that you are to apply it to, as near as can be had.

Before you commence to lay varnish on work, see that your person is free from dust, lint, or any substance that will fly from you to the varnish; that the room is perfectly free from dust, or any current of air that may bring dust on to your work; and that your brush—which should be of good, fine elastic bristles—is carefully freed from all specks that will work out into the varnish wher

laid on. Sprinkle the floor of the varnish-room with water, which prevents the dust rising from the floor; dust off the work well with the duster, and have all specks removed from the work.

If you have a body to varnish, commence at the highest part first, and work downward. Use the brush, with a good supply of varnish in it, quickly, and draw the finishing stroke as straight as possible, very slightly pressing on to the work. When the work is thoroughly spread over, and evenly laid on, the least brushing that it gets after this the better. But this last direction must not be construed into carelessness about your work. The "sleight" is to lay the varnish evenly over the work in the shortest possible time that it can, and be well done. When varnishing over panels, they should be done first, and the raised parts afterward. Care should be taken about leaving varnish on the corners, or any other place where it will run down.

To varnish the carriage-part, the same rules should be observed; that is, to keep it free from dirt or the minute specks that are more or less constantly flying in the air. Sometimes these minute particles are in the varnish, and cannot be seen until the varnish is laid on to a smooth surface of paint, and then they show themselves plainly. To avoid them, the varnish should be filtered through a cloth. Two coats of the best wearing varnish laid over a polished surface of paint, are enough to make a good job, providing that it has been properly spread, and no accibent happened to it while drying. Varnish, when laid on with a brush, will show more or less the brush marks, as the bristles leave it in ridges. With only two coats of good flowing varnish, these ridges are scarcely percepti-

ble, but if you add more, it will make the ridges more plain, and then follows the necessity of polishing down the surface, and then putting on a single coat of finishing varnish. In the very best finished work this polishing the varnish is pursued, but, as we have said, it does not strike us as being a very good way to finish work. To polish varnish, there is an absolute necessity of its not only being dry, but being so dry and hard that it becomes brittle; but the more brittle it is, the easier it will polish. Now, good wearing varnish flows over the paint better, and is much longer in drying than the rubbing varnish; in fact, it never can be made to rub down as easily as rubbing varnish, and for that reason is very seldom used for that purpose.

In using rubbing varnish for the first coat, it will be necessary to let it dry hard before the next is put on, and in this way get three or four coats on the body, and well dried, before you undertake rubbing it down. Afterward, take some ground rotten-stone, mixed in water so that it will be as thick as cream, then take a woollen rag, made up into a shape suitable to rub the work with, and dip it into the rotten-stone, rubbing the varnish until all the brush marks are obliterated, and it then assumes a smooth, polished surface. Have a sponge and water handy, so that you can wash off the surface from time to time, to see if the object is accomplished; and when you have rubbed away every trace of a ridge that has been made by the brush on the surface of the varnish, the work of rubbing is over, and you must now wash work entirely clean, and then apply a coat of wearing varnish, as before directed.

The most common difficulty that arises about rubbing

paint or varnish is, that we do not give it a sufficient time to dry hard before we commence rubbing down. Again, paint or varnish that rubs down well will not wear on account of the necessity there is of adding more turpentine, which entirely evaporates from the paint, leaving less glutinous oil for holding the paint on to the wood. The fact of making paint or varnish easier to work by destroying its wearing quality, is a great temptation to the workman to get praise as a fancy workman at the expense of the wearing quality of his work. This last difficulty is avoided on the carriage-part by following the directions for laying on the paint as we have given them, and by so doing it obviates the difficulty of making paint brittle in order to have it rub down easy; also saves time, and makes a handsomer job.

POLISHES.

THE compositions used for polishing are different, according to the nature of the varnish for which they are employed. Some of the most useful I shall insert here.

Varnish Polish.

Take two ounces of tripoli, reduced to fine powder; put it into an earthen pot or basin, with water to cover it; then take a piece of fine flannel, four times doubled, lay it over a piece of cork or rubber, and proceed to polish your varnish, always wetting it with the tripoli and water. You will know when the process is completed, by wiping a part of the work with a sponge and observing whether there is a fair and even gloss. Take a bit of mutton-suet and fine flour, and clean off the work.

Or, the powdered tripoli may be mixed up with a little pure oil, and used upon a ball of serge, or of chamois leather, which is better. The polishing may afterwards be completed with a bit of serge or cloth, without tripoli.

Putty powder, and even common whiting and water, are sometimes used for polishing; but they produce a very inferior effect to tripoli, except in the case of ivory,

for which putty and water, used upon a rubber made of a hat, forms the best and quickest polish.

Putty and water may likewise be used, in the same manner as just mentioned for ivory, in finishing off the polish of pearl-work, after it has first been polished very smooth with pumice-stone, finely powdered, and well washed to free it from impurities and dirt.

Polish for Dark-coloured Woods.

Take one ounce of seed-lac, two drams of gum-guaiacum, two drams of dragon's blood, and two drams of gum mastic: put them into a vessel containing a pint of spirit of wine: stop the vessel close, and expose the mixture to a moderate heat till you find all the gums dissolved: strain it off into a bottle for use, with a quarter of a gill of linseed oil, to be shaken up well with it.

The dragon's blood, which is apt to give a red tinge, renders this polish improper for light-coloured woods.

Polish for Tunbridge-ware Goods, &c.

Take half an ounce of gum sandrac and two ounces of gum benjamin; put them into a glass bottle, with a pint of spirits of wine. Cork the bottle, and place it in a sand-bath, or in hot water, till you find the gums dissolved, shaking it in the interim from time to time. When it is all dissolved, strain it through a muslin sieve, and bottle it for use.

Carver's Polish.

In a pint of spirits of wine, dissolve two ounces of seed-lac and two ounces of white resin.

The principal use of this polish is for the carved parts of cabinet-work, such as standards, pillars, claws, &c. It should be laid on warm; and if the work can also be warmed at the time, it will be still better; but all moisture and dampness should be carefully avoided.

French Polish.

Take one ounce of shell-lac, a quarter of an ounce of gum Arabic, and a quarter of an ounce of gum copal. Bruise them well, and sift them through a piece of muslin: then put them, along with a pint of spirits of wine, into a closely-corked vessel: place it in a very warm situation, and shake it frequently every day till the gums are dissolved: then strain it through a piece of muslin, and keep it tight corked for use.

Water-proof Polish.

Put two ounces of gum benjamin, a quarter of an ounce of gum sandrac, and a quarter of an ounce of gum anima, into a pint of spirits of wine, in a closely stopped bottle. Place the bottle either in a sand-bath or in hot water, till the gums are dissolved; then strain off the mixture, shake it up with a quarter of a gill of the best clear poppy oil, and put it by for use.

Finishing Polish.

Put two drams of shellac and two drams of gum benzoin into half a pint of the very best rectified spirits of wine, in a bottle closely corked. Keep the bottle in a warm place, and shake it frequently till the gums are dissolved; whèn cold, shake up with it two tea-spoonfuls of the best clear poppy oil, and it will be fit for use.

This polish may be applied with great advantage after any of those mentioned in the foregoing recipes have been used. It removes the defects existing in them, increases their lustre and durability, and gives the surface a most brilliant appearance.

Polish for Wainscot.

Take as much beeswax as will be sufficient for the work in hand, put it in an earthenware pan, cover it with 90 per cent. alcohol, and allow it to dissolve without the aid of heat. Rub the mixture, which should be of the consistency of butter, into the grain of the wood, and clean it off with clean linen rags. A good gloss is produced on the wood. The polish may be colored, if desired.

White Polish for Light Woods.

Dissolve bleached shellac 3 ozs., white gum benzoin 1 oz., gum sandarac ½ oz., in alcohol or wood naphtha 1 pint.

French Polish for Carved Wood in Furniture.

Reduce 30 parts of shellac, 7 of gum arabic and 15 of copal to a fine powder by pounding in a mortar, and sift the powder through a piece of muslin or a fine-mesh hair sieve. Put the sifted powder in a capacious

flask or bottle and pour 700 parts of spirits of wine over it; cork up the bottle and stand it in a moderately warm place until the resins are thoroughly dissolved in the spirit. Several days will be required to accomplish this; then strain the fluid through a piece of muslin into the wide neck of a flask or bottle—a pickle bottle or jar answers very well—press the muslin an inch or two down the neck, and tie the overlapping edges round the neck with a piece of string. By pouring the polish a little at a time into the hollow of the muslin, it will be strained as it passes through.

Apply the polish with a soft hair brush to the carved parts; a beautiful gloss and richness of color are at once given to the carvings.

To prepare a *finish* to use after the application of the above polish: Dissolve shellac 3 parts and gum benzoin 8, in a bottle with rectified spirits of wine 350. Cork up the bottle, and let the mixture digest in a warm place, shaking frequently. When the mixture is fluid and cold, put in a small quantity of best poppy-seed oil, which should be as clear as water; mix all intimatelv together, and keep it for use.

Polish for Wood.

Dissolve shellac 3 parts, solution of collodion cotton 100 parts and camphor 50 parts, in a sufficient quantity of ethyl alcohol.

For a *finish*, mix benzole and alcohol.

Polish for Carved Cabinet War

Dissolve seed-lac 2 ozs., and white resin 2 ozs., in 1 pint of 90 per cent. alcohol.

Warm the article to be polished, if practicable, so as to dry it and drive out all dampness, and then lay the

polish on the warm wood, the polish itself being warmed. For standards or pillars of cabinet work, the polish should be laid on with a brush, while for carved parts it should be used as follows: Varnish the parts with ordinary wood varnish, and having dressed them off where necessary with emery paper, apply the polish.

Renovating Polish for Fine Carved Work.

Mix 8 ozs. linseed oil, 8 ozs. old ale, the white of 1 egg, 1 oz. hydrochloric acid and 1 oz. spirit of wine. Let the whole digest until thoroughly incorporated.

Shake well before using, and apply a little to the face of a soft linen pad, and lightly rub the pad for a minute or two over the article to be restored, which is afterwards to be polished off with an old silk handkerchief. This polish will keep any length of time, if the bottle be well corked.

Mahogany Polish.

Best shellac $8\frac{3}{4}$ ozs., 96 per cent. alcohol $33\frac{1}{2}$ ozs. Put the alcohol and shellac into a bottle or jar, cover its mouth with muslin or paper pierced with holes, or a cork with a small hole through it, and effect solution by standing the bottle in a vessel of boiling water.

Red Polish.

Beeswax 4 ozs., alkanet 4 drachms, oil of turpentine 16 ozs. Digest the alkanet in the turpentine until the fluid is sufficiently colored; then scrape the beeswax fine and thoroughly incorporate all the ingredients by digesting the mixture by the heat of a water bath.

Polish for Satinwood or Maple.

Mix chrome yellow ¼ oz. and French polish 1 gill. Use in the same manner as French polish (see below.) A little chrome yellow on the rubber is desirable. In French polishing always use a drop of linseed oil on the rubber.

French Polish.

Finest shellac 4⅕ ozs., dragon's blood 1 oz., turmeric 7¾ grains, 96 per cent. alcohol 50 ozs. Dissolve the shellac in one-half the prescribed quantity of alcohol and dissolve it in a sand bath. In a second bottle dissolve the dragon's blood in the remainder of the alcohol. When all is dissolved, pour the two solutions together and mix by shaking; then add the turmeric, shake well, and let the mixture stand undisturbed for 24 hours. Then filter it.

PRACTICE OF VARNISHING AND POLISHING.

BEFORE beginning to varnish, you must fill up any knots or blemishes with cement of the same colour as the ground. Have your varnish in a pan, such as I have before described, with a piece of wire running diametrically across the top, and slackened downwards, to stroke your brush against. Be careful that the brush be clean and free from loose hairs; dip it in the varnish, stroking it across the wire, and give the work a thin regular coat; soon after that, another; and so continue; always taking care not to pass the brush twice over the same place in any one coat, as that would render it unequal.

The greatest difficulty of the operation consists in preventing the different strokes of the brush from being visible. To avoid this, let the brush be perfectly flat and as large as the nature of the work will permit. Draw it gently over the surface, in taking your strokes, and be careful not to load the brush with too much varnish at once.

Turned articles are always best varnished while in the lathe, by means of heat; because the extension of the varnish is then more uniform and the operation facilitates the polishing afterwards.

When varnish is applied to painting in distemper, it is necessary to allow sufficient time to elapse between

the application of the distemper and that of the varnish to let the wood become perfectly dry; if this be not done, the varnish will penetrate into the size, and at last bring off the coat of colouring beneath along with it, in thin pieces.

For ordinary purposes, shell-lac varnish does not require to be rubbed down and polished; but, when it is wished to produce a very even surface, these processes are necessary: for rubbing down, pumice-stone in fine powder is used. A piece of woollen rag is made wet, and a portion of the powder put upon it; this is rubbed carefully and equally over every part of the varnished surface until it appear perfectly even. Great care is requisite to avoid rubbing through at some parts before others are rendered smooth, particularly if there are sharp edges or projecting mouldings. When this takes place, the whole process of varnishing must be repeated. A little practice will, however, enable any one to avoid this, provided the article varnished have an even surface and the number of coats have been sufficient to give the requisite thickness of resin. When the surface to be polished is flat, the cloth may, when used, be wrapped round a piece of cork or wood; and the same method may be adopted in rubbing down mouldings.

When a surface is well prepared by the pumice-stone, it is very easily polished. This is effected by fine rotten-stone, used exactly in the same way as the pumice-stone, excepting that sweet oil is used instead of water. The oil may be removed from the surface by a fine rag and some dry rotten stone; and if a little be then rubbed

on by the palm of the hand, this will give a high polish to the surface.

The gloss upon the shell-lac which has been polished is less brilliant than that of the unpolished varnish, but this gloss may be given by using a coat of seed-lac varnish, which will abstract but little from the perfect surface given by polishing.

In some cases, hard bodies may be allowably employed in polishing varnishes, but only when these varnishes are themselves hard, such as those resulting from the solution of amber and copal in drying oil, or even in oil of turpentine.

When it is required to clean and polish old furniture, first wash it thoroughly with hot *soft* water to get the dirt off; then take a quart of stale beer or vinegar, put in a handful of common salt and a table-spoonful of spirits of salt, and boil it for a quarter of an hour; keep it in a bottle, and warm it when wanted for use. This mixture should be applied as long as necessary after the furniture has been washed with the hot water.

French Polish.

There is a mode of using shell-lac varnish which is sometimes denominated the German, but more commonly the French mode. It merits to be generally known, as the process is easy and economical, and the effect beautiful. It has been much employed by cabinet and musical instrument makers, but is not yet so extensively practised as it merits to be.

The varnish is applied by means of what is called a rubber, made by rolling up a piece of thick woollen cloth, which has been *torn* off so as to have a soft, elastic edge. The varnish, put into a narrow-mouthed bottle, is applied to the middle of the flat face of the rubber by laying the rubber on the mouth of the bottle and quickly shaking the varnish at once, as the rubber will thus imbibe a sufficient quantity to varnish a considerable extent of surface. The rubber is then enclosed in a soft linen cloth doubled, the remainder of the cloth being gathered together at the back of the rubber to form a handle to hold it by; and the face of the linen cloth must be moistened with a little raw linseed-oil, which may either be coloured with alkanet root or not, applied with the finger to the middle of it.

The work to be varnished should be placed opposite to the light, in order that the effect of the polishing may be better seen, and a surface of from ten to eight feet square may be varnished at once.

The rubber must be quickly and lightly rubbed upon the surface of the article to be varnished, and the rubbing continued until the varnish becomes nearly dry. The coil of woollen cloth must then be again wetted with the varnish, (no more oil need be applied to the surface of the linen cloth,) and the rubbing renewed till the varnish becomes nearly dry as before; a third coat must be applied in the same manner, then a fourth with a little oil, which must be followed by two others without oil, as before. You proceed thus until the varnish has acquired some thickness, which will be after a few repetitions

of the series. Apply then a little alcohol to the inside of the linen cloth, and wet the coil with the varnish; after which, rub very quickly, lightly, and uniformly, over every part of the varnished surface, which will tend to make it even, and very much conduce to its polish. The linen cloth must now be wetted with a little alcohol and oil, without varnish; and the varnished surface being rubbed over, with the precautions last mentioned, until it is nearly dry, the effect of the operation will be seen. If it be found not complete, the process must be continued, with the introduction of alcohol in its turn as directed before, until the surface becomes smooth and of a beautiful lustre.

The preceding process is that in general use; but Dr. Jones recommends, in the *Franklin Journal*, a rubber of a different sort, as well as a simpler mode of employing it. He takes a piece of thick woollen cloth, six or eight inches in diameter, and upon one side of this pours a tea-spoonful of the varnish; he then collects the edges together, so as to enclose the varnish in the cloth and form a handle by which to hold it: this is finally covered with a piece of oiled linen cloth, and the rubber is ready for use. More varnish is added as often as it is required; and when it becomes occasionally too thick to ooze through, a little alcohol is poured into the cloth.

Some difficulties may be at first experienced in performing this process; but Dr. Jones states that a very little practice will enable any handy person to surmount them. The peculiar advantage said to attend it is, that a beautiful polish may be at once obtained by a continued

application of the rubber in this way; while, according to the method previously described, successive coats of varnish, which require considerable time to dry, must be used, and a great deal of additional trouble incurred.

In varnishing recesses or carved work, where parts of the surface are difficult to reach with the rubber, a spirit varnish, made with or without lac of the usual gum resins, and considerably thicker than that used for the rest of the work, may be applied to those parts with a brush or hair pencil.

Waxing.

In some instances, the application of wax merely is preferred to any varnish; particularly in the case of chairs, tables, &c., of walnut-tree wood, in daily use.

Waxing resists percussion and friction, but it does not possess, in the same degree as varnish, the property of giving lustre to the bodies to which it is applied, and of heightening their tints. The lustre created by wax is but dull; but this inconvenience is balanced by the ease with which any accidents that may have effected its polish can be replaced by rubbing it with a piece of fine cork.

In waxing, it is of great importance to make the coating as thin as possible, in order that the veins of the wood may be more distinctly seen. I consider the following preparation the best for performing this operation :—

Put two ounces of white and yellow wax over a moderate fire, in a very clean vessel, and, when it is quite

melted, add four ounces of the best spirits of turpentine. Stir the whole until it is entirely cool, and you will have a pomade fit for waxing furniture, which must be rubbed over it according to the usual method. The oil soon penetrates the pores of the wood, brings out the color of it, causes the wax to adhere better, and produce a lustre equal to that of varnish, without being subject to any of its inconveniences.

Another polishing wax for furniture is prepared as follows: Melt 8 parts white wax, 2 parts resin, and ½ part Venice turpentine over a moderate fire, and pour the compound while warm into a suitable earthenware pot, and then stir in the oil of turpentine. In twenty-four hours the polish will have assumed the consistency of soft butter, and is then ready for use. Carefully cleanse the furniture with soap water, and when dry apply the polish in a thin layer with a woolen rag, rubbing first gently and then more vigorously. Let the furniture stand for a quarter to half an hour, and rub over more thoroughly with a woolen cloth.

ON LACQUERING.

THE general nature of the compositions employed for lacquering has already been explained under the head of Changing Varnishes. I shall in this place give some particular receipts for preparing the lacquers in most general use.

Lacquer for Brass.

Seed-lac, six ounces; amber or copal, ground on porphyry or very clean marble, two ounces; dragon's blood, forty grains; extract of red sandal-wood, thirty grains; oriental saffron, thirty-six grains; pounded glass, four ounces; very pure alcohol, forty ounces.

Articles, or ornaments of brass, to which this varnish is to be applied, should be exposed to a gentle heat and then dipped into the varnish. Two or three coatings may be thus applied, if necessary.

Articles varnished in this manner may be cleaned with water and a bit of dry rag.

Lacquer for Philosophical Instruments.

Gamboge, an ounce and a half; gum sandrac, four ounces; gum elemi, four ounces; best dragon's blood,

two ounces; terra merita,* an ounce and a half; oriental saffron, four grains; seed-lac, two ounces; pounded glass, six ounces; pure alcohol, forty ounces.

The dragon's blood, gum elemi, seed-lac, and gamboge are all pounded and mixed with the glass. Over them is poured the tincture obtained by infusing the saffron and terra merita in the alcohol for twenty-four hours. This tincture, before being poured over the dragon's blood, &c., should be strained through a piece of clean linen cloth, and strongly squeezed.

If the dragon's blood gives too high a colour, the quantity may be lessened according to circumstances. The same is the case with the other colouring matters.

This lacquer has a very good effect when applied to many cast or moulded articles used in ornamenting furniture.

Gold-coloured Lacquer for Brass Watch-cases, Watch-keys, &c.

Seed-lac, six ounces; amber, two ounces; gamboge, two ounces; extract of red sandal-wood in water, twenty-four grains; dragon's blood, sixty grains; oriental

* Terra merita is the root of an Indian plant; it is of a red colour, and much used in dyeing. In varnishing, it is only employed in the form of a tincture, and is particularly well adapted for the mixture of those colouring parts which contribute the most towards giving metals the colour of gold. In choosing it be careful to observe that it is sound and compact.

saffron, thirty-six grains; pounded glass, four ounces; pure alcohol, thirty-six ounces.

The seed-lac, amber, gamboge, and dragon's blood must be pounded very fine on porphyry or clean marble, and mixed with the pounded glass. Over this mixture is poured the tincture formed by infusing the saffron and the extract of sandal-wood into the alcohol, in the manner directed in the last receipt. The varnishing is completed as before.

Metal articles that are to be covered with this varnish are heated, and, if they are of a kind to admit of it, are immersed in packets. The tint of the varnish may be varied in any degree required, by altering the proportions of the colouring quantities according to circumstances.

To make Lacquer of various Tints.

For this purpose, make use of the receipt given under the head of Changing Varnishes.

To clean old Brass Work for Lacquering.

First boil a strong lye of wood-ashes, which you may strengthen with soap-lees; put in your brass work, and the lacquer will immediately come off; then have ready a pickle of aqua-fortis and water, strong enough to take off the dirt; wash it immediately in clean water, dry it well, and lacquer it.

Process of Lacquering Brass.

Be sure that all oil or grease is removed before laying on the lacquer. Hold the article with spring tongs or with a taper stick in some of the holes so as to avoid touching it with the fingers. Always handle the article with a piece of clean cloth. Heat the work so hot that the brush will smoke when applied, but avoid overheating, as it burns the lacquer. It is well to fasten a small wire across the lacquer pot from side to side, to scrape off any superfluous lacquer from the brush, the ends of the hairs of which should be all exactly even. If not so, trim the ends with sharp scissors. Scrape the brush as dry as possible on the wire, making a flat smooth point at the same time. Use the very tip of the brush to lacquer with, and have a steady hand to avoid slopping. Two coats at least should be applied. To make the coat durable, it is as well to blaze off after each coat with a spirit lamp or Bunsen burner, being very careful not to overheat or burn the lacquer. If the lacquer be too thick, it will look gummy on the work; if too thin, it will show prismatic colors. In the first case, dilute with alcohol; in the latter case, set the pot on the stove and evaporate some of the spirit. A good deal of cheap work is dipped. Use a bath of equal parts of sulphuric and nitric acid, dip the work, hang it on the wire for a moment, then remove and rinse it thoroughly in cold water, dip in hot water, remove, put in lacquer, shake vigorously on removing to throw off extra lacquer, and lay on a warm metal plate till dry; let it cool and the work is done. Avoid handling lacquered work until cold.

Lacquer for Sign Painters.

Dissolve elemi 2 ozs., mastic $2\frac{1}{2}$ ozs., sandarac 5 ozs., and shellac 5 ozs., in spirits of wine 50 ozs. In another vessel mix 2 ozs. of oil of turpentine and 2 ozs. of Venice turpentine, and add the mixture to the solution of resins.

Black Lacquer for Wood.

Elemi 1 oz., seed-lac 1 oz., mastic 1 oz., sandarac 1 oz., shellac 2 ozs., Venice turpentine 1 oz., alcohol 20 ozs., bone-black 1 oz.

Rub up the bone-black in the turpentine and add the mixture to the solution formed by dissolving the resins in the alcohol.

Lacquer for Floors.

I. Dissolve colophony 10 parts, ruby shellac 20, and Venice turpentine 5, in spirits of wine 100.

II. Dissolve colophony 15 parts, ruby shellac 10, oil of turpentine 5, in spirits of wine 60.

III. Dissolve $5\frac{1}{4}$ ozs. shellac in 17 gills alcohol.

This lacquer is for use on floors which have been painted any color. The thin coat of lacquer will make the color more durable than would be the case without it.

Red Lacquer for Wood.

Elemi 1 oz., mastic 1 oz., sandarac 4 ozs., shellac 2 ozs., Venice turpentine 2 ozs., alcohol 25 ozs., dragon's blood $\frac{1}{2}$ oz.

Dissolve the red coloring matter in a little alcohol, separately dissolve the other solids in the remainder of the alcohol, then add the turpentine and the tinc-

ture of dragon's blood. Mix by thorough shaking, and filter.

Ebony Lacquer for Woodwork.

Dissolve, on the one hand, 1 oz. of aniline hydrochloride in 1 oz. of alcohol, and, on the other, 1 part of sulphate of copper in 100 parts of water.

Coat the wood with the copper sulphate solution, let it dry thoroughly, and then apply the aniline hydrochloride solution. In a short time the copper salt that has been absorbed by the wood will react on the aniline hydrochloride, producing a deep black color. This combination has been called nigrosine, and cannot be destroyed either by acids or alkalies. The wood may, therefore, be left without further coating, but if it is desired to give it lustre, a coating of ordinary cabinet-maker's varnish suffices for the purpose.

Lacquer for Basket and Wicker Work.

A lacquer which shall answer for this purpose must possess a certain degree of elasticity, and can be prepared without great difficulty as follows: Boil a good quality of linseed oil in a capacious vessel until a drop of it, when poured upon a cold stone slab, becomes so viscid that it tenaciously adheres to the finger when touched, and can be drawn out in long threads. Mix 1 part of the linseed oil thus prepared with 20 parts of good fat copal varnish and reduce to the desired consistency with oil of turpentine. To color this lacquer, if required, it is best to use aniline colors dissolved in benzole and to mix the solution intimately with the lacquer.

Lacquer for Wall Paper.

Dissolve equal parts of borax and shellac in 10 times their weight of alcohol. Strain the solution and apply two coats of it to the wall paper, in the usual manner with a brush, the first coat being allowed to dry thoroughly before applying the second. The lacquer may be applied to the paper either before or after it is put on the wall.

For every light-colored paper use sandarac instead of shellac. Paper treated with this lacquer can be washed with water, and even with soap if necessary.

BRONZING.

THIS art is nothing but a species of painting; but far from being of the most delicate kind. The principal ingredients made use of in it are the true gold powder. the German gold, the aurum mosaicum, (all before described,) and copper powder. This last may be procured by dissolving filings or slips of copper with nitrous acid in a receiver. When the acid is saturated, the slips are to be removed; or, if filings be employed, the solution is to be poured off from what remains undissolved. Small bars are then put in, which will precipitate the copper from the saturated acid, in a powder of the peculiar appearance and colour of copper; and the liquid being poured from the powder, this is to be washed clean off the crystals by repeated levigations.

The choice of these powders is, of course, to be determined by the degree of brilliancy you wish to obtain. The powder is mixed with strong gum water or isinglass, and laid on with a brush or pencil; or, a coating of gold-size, prepared with a due proportion of turpentine, is first applied; and when not so dry as to have still a certain clamminess, a piece of soft leather, wrapped round the finger, is dipped in the powder and rubbed over the work. When the work has, in either of these ways, been all covered with the bronze, it must be left

to dry, and any loose powder then cleared away by a hair pencil.

Bronzing in wood may be effected by a process somewhat differing from the above. Prussian blue, patent yellow, raw amber, lamp-black, and pipe-clay are ground separately with water on a stone, and as much of them as will make a good colour put into a small vessel, three-fourths full of size, not quite so strong as what is called clean size. This mixture is found to succeed best on using about half as much more pipe-clay as of any of the other ingredients. The wood being previously cleaned and smoothed, and coated with a mixture of clean size and lamp-black, receives a new coating with the above compound twice successively, having allowed the first to dry. Afterwards the bronze-powder is to be laid on with a pencil, and the whole burnished or cleaned anew, observing to repair the parts which may be injured by this operation. Next, the work must be coated over with a thin lather of Castile soap; which will take off the glare of the burnishing, and afterwards be carefully rubbed with a woollen cloth. The superfluous powder may be rubbed off when dry.

In *bronzing iron*, the subject should be heated to a greater degree than the hand can bear; and German gold, mixed with a small quantity of spirit-of-wine varnish, spread over it with a pencil. Should the iron be already polished, you must heat it well and moisten it with a linen rag dipped in vinegar.

There is a method of bronzing casts of plaster of Paris analogous to that which we have above given for bronz-

ing wood; but it is not in much repute. Such figure may be beautifully varnished by means of the following composition, recommended by Dr. Johns, of Manchester, England, in the *Mechanics' Magazine*, vol. iv. pp. 303, 352. Of white soap and white wax, take each half an ounce; of water, two pints; boil them together for a short time in a clean vessel. This varnish is to be applied when cold, by means of a soft brush. It does not sink in; it readily dries; and its effect may be heightened by lightly using a silk pocket handkerchief.

Bronze Paint.

1. Gold size 2 ozs., copal varnish 2 ozs., turpentine 4 ozs., and a sufficient quantity of bronze powder.

2. *Liquid for bronzing paper, leather, glass, etc.* Dissolve 10 parts diamond fuchsine and 5 parts methyl violet, by the aid of heat, in 95 per cent. alcohol. Then add 5 parts benzoic acid and boil 5 or 10 minutes, till the green color has changed to a lustrous bronze. It is easily laid on with a brush, dries rapidly, and is brilliant, durable and adherent.

3. *Bronze paint for plaster.* Boil 3 lbs. pure linseed oil with 12 ozs. finely powdered litharge, strain through coarse cloth, and allow to stand till clear. Mix 15 ozs. of this soap-varnish with 12 ozs. metallic soap powder made as follows: To a solution of soda soap in linseed oil, cleared by straining, add a mixture of 4 parts sulphate of copper solution and 1 part sulphate of iron solution, which precipitates a metallic soap of a peculiar bronze color. To the mixture are then added 5 ozs. fine white wax, melted on a water bath, and allowed to remain in a melted state to expel any moisture present. It is then applied with a brush

to the surface of the plaster, previously heated to 200° F., being careful to lay it on smoothly and without filling up any indentations of the plaster design. Place it for a few days in a cool place, and as soon as the smell of the soap varnish has gone off, rub the surface over with cotton-wool or a fine linen rag, and variegate with a few streaks of metal powder or shell gold.

4. *For iron or brass.* Chrome green 2 lbs., ivory black 1 oz., chrome yellow 1 oz., good japan 1 gill. Grind all together and mix with linseed oil.

5. *Antique bronze.* Sal ammoniac 2 ozs., cream of tartar 6 ozs., common salt 12 ozs. Dissolve in 1 quart of hot water, add 4 ozs. of nitrate of copper, mix, and apply several times with a brush to the article.

Bronzing Inlaid Work.

A method employed for decorating inlaid work is the use of a bronzing liquid, which consists of a fluid bronze composition formed by combining metallic powder of gilding and bronze powder with collodion. This composition is capable of being applied as a bronze liquid to the surfaces of wood, iron, or any solid material, for the purpose of coating the same for decoration or preservation.

To Bronze Steam Pipes used for Steam Heating.

Use ordinary chrome yellow for painting the pipes. When this is nearly dry, rub on gold bronze powder with a piece of fur. Varnish with thin copal varnish or mastic varnish, when thoroughly dry.

Size for Bronze Powder for Iron.

To one pint of methylated finish add 4 ozs. of gum

shellac and ½ oz. gum benzoin. Put the bottle in a warm place and shake it occasionally. When the gums are dissolved, let the bottle stand in a cool place two or three days for the solution to settle. Pour off the clear portion and reserve it for the finest work, using the sediment, which by the addition of more alcohol may be made workable, when strained, for first coat or coarser work. Add a sufficient quantity of the bronze to this, and apply to the clean, smooth, warm iron, using a soft brush. Repeat, after drying, if necessary. Thin with alcohol, if necessary, to avoid wrinkles and brush-marks. Varnish over all.

Bronzing Wood.

Cover the wood with a uniform coating of glue or of drying oil, and when nearly dry, dust over it the bronze powder contained in a small bag. The surface of the object is afterwards rubbed with a piece of moist rag. Or the bronze powder may be previously mixed with the drying oil, and applied with a brush.

JAPANNING.

ALL wood work intended to be japanned must be prepared with size, and some coarse material mixed with it to fill up and harden the grain of the wood, (such as may best suit the colour intended to be laid on,) which must be rubbed smooth with glass paper when dry. In cases of accident, it is seldom necessary to re-size the damaged places, unless they are considerable.

Be very careful, in japanning, to grind your colours smooth in spirit of turpentine; then add a small quantity of turpentine and spirit varnish; lay it carefully on with a camel-hair brush, and varnish it with brown or white spirit varnish, according to the colour.

Colours required in Japanning.

Flake white, red lead, vermilion, lake, Prussian blue, patent yellow, orpiment, ochres, verditers, Vandyke brown, umber, lamp-black, and siennas raw and burnt. With these you may match almost any colours in general use in japanning. For a black japan, it will be found sufficient to mix a little gold-size with lamp-black; this will bear a good gloss, without requiring to be varnished afterwards.

To Prepare a Fine Tortoise-shell Japan Ground by Means of Heat.

Take one gallon of good linseed oil, and half a pound of umber; boil them together till the oil becomes very brown and thick: then strain it through a coarse cloth, and set it again to boil; in which state it must be continued till it acquire a consistence resembling that of pitch; it will then be fit for use.

Having thus prepared the varnish, clean well the substance which is to be japanned. Then lay vermilion tempered with shell-lac varnish or with drying oil very thinly diluted with oil of turpentine, on the places intended to imitate the more transparent parts of the tortoise-shell. When the vermilion is dry, brush the whole over with black varnish, tempered to a due consistence with the oil of turpentine. When set and firm, put the work into a stove, where it may undergo a very strong heat, which must be continued a considerable time; if even three weeks or a month, it will be the better.

This tortoise-shell ground is not less valuable for its great hardness, and endurance of heat greater than that of boiling water, without suffering damage, than for the superior beauty and brilliancy of its appearance.

Japan Finishing.

The finishing part of japanning lies in laying on and polishing the outer coats of varnish, which is necessary in all-painted or simply ground colored japan work. When brightness and clearness are wanted, a white kind of varnish is necessary, for seed-lac varnish, which is the hardest and most tenacious, imparts a yellow tinge. A mixed varnish is best for this

purpose, that is for combining hardness and purity. Take then 3 ozs. of seed-lac, picked very carefully from all sticks and dirt, and wash it well with cold water, stirring it up and pouring off the water, and continuing the process until the water runs off perfectly pure. Then dry the shellac, and after having it reduced to powder, put it with a pint of alcohol into a bottle, of which it must occupy only two-thirds of its space. This mixture must be shaken well together and the corked bottle kept in a warm place until the shellac is dissolved. When this is the case the clear portion is to be poured off and the remainder strained through a cloth, and after combining both, the clear and strained portions, keep them in a well-stoppered bottle. This seed-lac varnish is used in the usual manner and a fine polishing varnish is made by mixing it with pure white varnish. The pieces of work to be varnished for finishing should be placed near a stove or in a warm, dry room, and one coat should be perfectly dry before the other is applied. The varnish is applied by proper brushes, beginning at the middle, passing the stroke to one end, and with the other stroke from the middle to the other end. Great skill is required in laying on these coats of varnish. If possible the brush should never cross or twice pass over in giving one coat. When one coat is dry, another must be laid over it, and so on successively for a number of coats, so that the coating will be sufficiently thick to stand fully all the polishing so as not to bare the surface of the colored work. When a sufficient number of coats are thus laid on, the work is fit to be polished, which, in common cases, is commenced with a rag dipped in finely powdered rotten-stone, and toward the end of the rubbing a little oil should be used along

with the powder. When the work appears fine and glossy a little oil should be used alone to clean off the powder and give the work a still brighter hue. In very fine work French whiting should be used, which should be washed in water to remove any sand that might be in it. Pumice stone ground to a very fine powder is used for the first part of the polishing, and the finishing is done with whiting. It is always best to dry the varnish of all japan work by heat. For wood work heat must be sparingly used, but for metals the varnish should be dried in an oven, also for papier mache and leather. The metal will stand the greatest heat, and care must be taken not to darken by too high a temperature. When gold size is used in gilding for japan work, where it is desired not to have the gold shine or appear burnished, the gold size should be used with a little spirits of turpentine and a little oil; but when a considerable degree of lustre is wanted without burnishing and the preparation necessary for it, a little of the size along with oil alone should be used.

Imitation of Japanning.

The peculiar glossy surface of the so-called japan trays can only be given by practice, but a close imitation may be effected as follows: Mix ivory black with melted size, apply the mixture quite hot to the box or any other wooden article that it may be desired to treat in this manner. When dry, sandpaper the box and then give it another coat of black. When this second coat is dry, bring to smoothness with sand paper, at the same time taking care not to remove the stain, so that the light wood underneath is exposed. Now procure 1 lb. of black japan and 1 gill of turpen-

tine. Mix enough of the black japan for present use with turpentine, of which only sufficient should be taken to make the japan fluid enough to run from the brush. A fine-haired paint brush should be employed. If properly done one coat will be sufficient. The box will look nearly equal to the Japan goods. Dry the varnished box in a warm room free from dust.

GILDING MATERIALS.

True Gold Powder.

PUT some gold leaf, with a little honey or thick gum-water, into an earthen mortar, and pound the mixture till the gold is reduced to very small particles. Then wash out the honey or gum repeatedly with warm water. and the gold will be left behind in the state of powder, which, when dried, is fit for use.

Another, and perhaps better method of preparing gold powder, is to heat a prepared amalgam* of gold in a clean open crucible, continuing a very strong heat till all the mercury has evaporated, stirring the amalgam all the while with a glass rod. When the mercury has entirely left the gold, grind the remainder in a Wedgewood's mortar, with a little water; and, when dried, it will be fit for use. The subliming the mercury is, however, a process injurious to the health.

Colour-heightening Compositions.

For Yellow Gold, dissolve in water six ounces of saltpetre, two ounces of copperas, one ounce of white vitriol,

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* An amalgam of any metal is formed by a mixture of quicksilver with that metal.

and one ounce of alum. If wanted redder, add a small portion of blue vitriol.

For Green Gold, dissolve in water a mixture consisting of an ounce and a half of saltpetre, vitriol, and sal-ammoniac, an ounce and a quarter each, and one ounce of verdigris.

For Red Gold, take an ounce and a half of red ochre in fine powder, the same quantity of *calcined* verdigris, half an ounce of calcined borax, and four ounces of melted yellow wax. The verdigris must be calcined, or else, by the heat applied in melting the wax, the vinegar becomes so concentrated as to corrode the surface, and make it appear speckled.

Mosaic Gold.

Mosaic Gold, or *Aurum Mosaicum*, is used for inferior articles. It is prepared in the following manner: A pound of tin is melted in a crucible, and half a pound of purified quicksilver added to it: when this mixture is cold, it is reduced to powder, and ground with half a pound of sal-ammoniac and seven ounces of flower of sulphur, till the whole is thoroughly mixed. They are then calcined in a matras; and the sublimation of the other ingredients leaves the tin converted into the *Aurum Mosaicum*, which is found at the bottom of the glass, like a mass of bright flaky gold powder. Should any black or discoloured particles appear, they must be removed. The sal-ammoniac used here must be very white and clear, and the mercury quite pure and unadulterated. When a shade of deeper red is required, it can easily be

obtained by grinding a very small quantity of red lead along with the above materials.

Dutch or German Gold.

A gilding powder is sometimes made from Dutch Gold, which is sold in books at a very low price. This is treated in the same way as the real gold leaf in making the true gold powder. It is necessary, when this inferior powder is used, to cover the gilding with a coat of clear varnish, otherwise it soon loses its metallic appearance. The same remark applies, though in a less degree, to Mosaic gilding.

Ethereal Solution of Gold.

The following mode of effecting this solution (used chiefly for gilding steel) is recommend by Mr. H. Mill, in the "Technical Repository," as being superior to any previously made known. "The instructions," he says, "given in most elementary works on chemistry for this purpose are either erroneous or not sufficiently explicit." The process answers equally well for either gold or platina.

Dissolve any quantity of gold or platina in nitro-muriatic acid, (*aqua regia,*) until no further effervescence is occasioned by the application of heat. Evaporate the solution of gold or platina, thus formed, to dryness, in a gentle heat, (it will then be freed from all excess of acid, which is essential,) and re-dissolve the dry mass in as little water as possible: next take an instrument which

is used by chemists for dropping liquids, known by the name of a separating funnel, having a pear-shaped body, tapering to a fine sharp point, and a neck capable of being stopped with the finger or a cork, which may contain a liquid ounce or more; fill it with the liquid about one-quarter part, and the other three parts must be filled with the very best sulphuric ether. If this be rightly managed, the two liquids will not mix Then place the tube in a horizontal position, and gently turn it round with the finger and thumb. The ether will very soon be impregnated with the gold or platina, which may be known by its changing its colour: replace it in a perpendicular position, and let it rest for twenty-four hours; having first stopped up the upper orifice with a cork. The liquid will then be divided into two parts—the darkest colouring being underneath. To separate them, take out the cork and let the dark liquid flow out: when it has disappeared, stop the tube immediately with the cork, and what remains in the tube is fit for use, and may be called gilding liquid. Let it be put into a bottle, and tightly corked.

The muriate of gold or platina, formed by digesting these metals in nitro-muriatic acid, must be entirely free from all excess of acid; because it will otherwise act too forcibly on the steel, and cause the coating of gold to peel off. Pure gold must be employed: the ether must not be shaken with the muriate of gold, as is advised in chemical publications, for it will be sure, then, to contain acid; but if the two liquids be brought continually into contact by the motion described, the affinity between

ether and gold is so strong as to overcome the obstacle of gravity, and it will hold the gold in solution. The ethereal solution may also be concentrated by gentle evaporation.

Gold Oil-colour, or Size.

The English method of preparing the colour in size, which serves as the ground on which the gold is laid, is, to grind together some red oxide of lead with the thickest drying oil that can be procured—the older the better. To make it work freely, it is mixed, before being used, with a little oil of turpentine, till it is brought to a proper consistence. (See, also, *Mordant Varnishes.*)

Gold Water Size.

One pound of Armenian bole, two ounces of red lead, and a sufficient portion of black lead, are ground separately in water, and then mixed, and re-ground with nearly a spoonful of olive oil. The gold size is tempered by mixing it in parchment size which is clear and clean, and has been passed through a fine sieve to clear it of all foreign matters. The *parchment* size is made by boiling down pieces of white leather, or clippings of parchment, till they are reduced to a stiff jelly.

Preparatory Size.

Boil a handful of the leaves of wormwood and two or three heads of garlic in a quart of water, until the liquid is reduced to one-half; then strain it through a cloth,

and add half a handful of common salt, and nearly half a pint of vinegar. The design of this composition (usually employed in gilding looking-glass and picture frames) is to obviate the greasiness of the wood, and prepare it the better to receive the coats which are to be laid on, and to preserve it from the ravages of worms. When used, it is mixed with a sufficient portion of good glue, boiling hot. In applying it to the gilding of plaster or marble, the salt must be left out of its composition; as, in damp situations, this would produce a white saline efflorescence on the surface of the gold.

White Coating.

A quart of strong parchment size and half a pint of water are to be made quite hot, and to this are to be added (in small portions from time to time) two good handfuls of common whiting passed through a fine sieve: this mixture is to be left to infuse for half an hour, when it is to be stirred carefully so that the amalgamation may be perfect.

Colouring Yellow.

Half a pint of parchment size is taken, which must be clean, white, and clear, and of one-half the strength of that used for the white coating; this is warmed, and there is mixed with it two ounces of yellow ochre, very finely ground in water; it is then left at rest, and the clear portion decanted, which gives a fine yellow colour, that serves, in water gilding, to cover those deep recesses

into which the gold cannot be made to enter; it serves also as a mordant for the gold size.

Vermeil.

This is a liquid which gives to the gold a warm reflection. It is composed of two ounces of anotto, one ounce of gamboge, one ounce of vermilion, half an ounce of dragon's blood, two ounces of salt of tartar, and eighteen grains of good saffron. The whole is to be boiled in a quart of water, over a slow fire, until it is reduced to one-fourth, when the liquor is passed through a strainer of silk or muslin.

Composition for Moulding.

The following is used by gilders: Mix 14 lbs. of glue, 7 lbs. resin, ½ lb. pitch, 2½ pints linseed oil, 5 pints of water, more or less according to the quantity required. Boil the whole together, with frequent stirring, until dissolved, add as much whiting as will render it of hard consistency, then press it into the mould which has been previously oiled with sweet oil. No more should be mixed than can be used before it becomes sensibly hard, as it will require steaming before it can be used again.

Another receipt is as follows: Make a very clear glue with 3 parts of glue and 1 part isinglass by dissolving the two kinds separately in a large quantity of water, and mix them together after they have been strained through a piece of linen to separate any particles not dissolved. The quantity of water cannot be fixed, because some kinds of glue require more than others. The proper strength may be found by suffering the glue to become perfectly cold; it must then barely form a jelly. The glue is to be gently heated, then

mixed with sawdust sifted through a fine sieve. The moulds are then to be oiled with nut oil and the glue pressed into the mould, covered with a weighted board, and then set to dry near a stove. When the casting is dry, it is trimmed.

Gold Size.

Heat ½ lb. linseed oil in a flask, and gradually add 2 ozs. of powdered anime, stirring the oil continuously until the whole of the resin is dissolved. Continue boiling until the mixture becomes a little thicker than tar, when it is to be strained through a coarse cloth. Previous to use, it is to be ground up with sufficient vermilion to render it opaque; and turpentine must be added in order that it may work freely.

Oil Size for Gilding.

Grind calcined red ochre with good old drying oil, and mix with it a little oil of turpentine when used. When the work is to be gilded, first give it a coat of parchment size; then apply the above size, where requisite, either in patterns or letters, and let it remain till, by touching it with the finger, it feels just sticky; then apply the gold leaf and dab it on with a little piece of cotton. In about an hour wash off the superfluous gold with sponge and water, and when dry varnish with copal varnish.

Gilder's Wax.

There are innumerable receipts for the preparation of gilder's wax, nearly every gilder having his own receipt, which he considers superior to all others. Only two formulæ, which yield good results, will here be given, one (I) for *reddish* gilding, and one (II) for *greenish* gilding.

I. Wax 12 parts by weight, pulverized verdigris 8, pulverized sulphate of zinc 4, copper scales 4, borax 1, pulverized bloodstone 6, copperas 2.

II. Wax 12 parts by weight, pulverized verdigris 4, pulverized sulphate of zinc 8, copper scales 2, borax 1, pulverized bloodstone 6, copperas 2.

Gilder's wax is prepared as follows: Melt the wax in an iron kettle, add to the melted mass, with constant stirring, the other ingredients, pulverized and intimately mixed, in small portions, and stir until cold, so that the powder cannot settle on the bottom or form lumps. Finally mould the soft mass into sticks about $\frac{1}{3}$ inch in diameter.

The operation for applying the gilder's wax is as follows: Coat the heated gilded articles uniformly with the wax and burn off over a charcoal fire, frequently turning the articles. After the extinguishment of the flame plunge the articles into water, scratch-brush with wine vinegar, dry in sawdust, and polish.

To give gilded metallic articles a beautiful rich appearance the following process may also be used: Mix 3 parts by weight of pulverized alum, 6 of saltpetre, 3 of sulphate of zinc and 3 of common salt, with sufficient water to form a thinly fluid paste. Apply this paste as uniformly as possible to the articles by means of a brush, and after drying, heat the coating upon an iron plate until it turns black, then wash in water, scratch-brush with wine-vinegar, dry and polish.

According to a French receipt, the same result is attained by mixing pulverized blue vitriol 3 parts by weight, verdigris 7, sal ammoniac 6, and saltpetre 6, with acetic acid 31; immersing the gilded articles in the mixture, or applying the latter with a brush, then

heating the articles upon a hot iron plate until they turn black, and after cooling, pickling in concentrated sulphuric acid.

Solution for Gilding Silver.

Dissolve equal parts by weight of bichloride of mercury (corrosive sublimate) and chloride of ammonia (sal ammoniac) in nitric acid. Add some grain gold to the mixture and evaporate the liquid to half its bulk. Apply while hot to the surface of the silver article.

PRACTICE OF GILDING.

Gilding Carved Wood with Water Size.

MIX with your preparatory size a sufficient portion of good glue, boiling hot, and lay it upon the wood with a brush, the bristles of which are short. Then apply six, eight, or ten coats, equal in quantity, of the white coating, and be particularly careful that the projecting parts are well covered, as the beauty of the burnish on the gold depends much on this. The first coat should be laid on quite hot, dabbing it with the brush in such a way that it may not be thicker in one place than another. The lower parts of the carving must be covered by dabbing it with a smaller brush. After putting on one coat of white, and before following it with a second, the work should be examined, any lumps in it reduced, and small hollows filled up by a cement consisting of whiting and glue kneaded together. Let the whole be now rubbed with fish-skin, which will remove every sort of roughness. The second, third, and remaining coats of white should have the size stronger than in the first coat, yet all of the same strength, otherwise a strong superior coat will cause a weaker one under it to scale off: the operation of dabbing with the brush must be repeated in every successive coat, in order to unite the whole, so that they may form a single compact body.

Each coat must also be perfectly dry before a new one is laid on. The whitened surface is now to be wetted with the brush which has been used for putting on the whiting, dipped in fresh cool water. Only a small portion should be wetted at once, which should then be rubbed down with pumice-stone, made flat for the parts which require to be of that form, and round or hollow, as may be necessary, for the mouldings. Little sticks are used for clearing out those members of the mouldings which may have been filled up by the whiting. The whitened parts are to be rubbed lightly, so as to render the surface smooth and even to the touch. At the same time, a brush which has become soft by using it with the whiting is employed to clear out all the dirt which has been found in the rubbing. The moisture is now to be dried up with a sponge, and any small grains which may remain removed by the finger—a delicate and very important operation. The whole work is finally to be wiped with a piece of clean linen.

The work should now be returned to the carver, to have the fine and delicate cutting of the sculptured parts restored. If the workman be skilful, he will be able to re-produce on the whiting every characteristic trait which may happen to have been obliterated. Where bas-reliefs cast from moulds are laid on a flat or carved surface, instead of the wood itself being carved, as is now very commonly the case, this repairing process is unnecessary.

A moistened cloth is now to be passed over the parts which are to be matted or burnished, and a soft moist-

ened brush over those which have been repaired. The whole is then to be washed with a soft sponge, and every speck and hair carefully removed. All the even parts should next be smoothed with rushes, taking care not to rub off the whiting. The colouring yellow is now to be applied very hot, with a soft clean brush, so as to cover the whole work. This application must be lightly made, so as not to disturb the whiting. The yellow tint serves to cover those deep recesses into which the gold cannot be made to enter: it serves also as a mordant for the gold size. When this yellow covering becomes dry, the whole surface is to be again gently rubbed with rushes, to remove all specks or hairs which may be found on it, and to give a uniform surface without the slightest inequality.

The gold size, which is the next thing to apply, you must temper by mixing it with some parchment size that has been passed through a fine sieve. It is to be laid on warm, with a small brush, the bristles of which are fine, long, and soft: there are brushes made for the express purpose. Three coats of the size will be sufficient. It is to be applied generally to the work, but you need not force it into the deeper parts. When the three coats of size are quite dry, the larger and smoother parts, which are intended to appear matted, are to be rubbed with a piece of new dry linen: this will cause the gold to extend itself evenly, and the water to flow over the sized surface without forming spots. To those parts which are not thus rubbed, but which are intended to be burnished, you must apply two additional coats of

the same tempered gold size, to which a little water has been added to render it thinner.

The work is now ready for Gilding.—Take a book of leaf gold, place the leaves upon a cushion, cut them to the required size, and lay them on the work by means of hair pencils of different sizes; first wetting the part (but that only) on which the gold is to be applied with fresh and cool water. The deep recesses should be gilt before the more prominent parts. When the leaf is deposited in its place, water is applied, to make it spread easily, by means of a pencil behind it, but so as it may not flow, as this would occasion spots; it should also be breathed on gently, and any waste water removed with the point of a pencil.

Those parts of the gilding which it is wished to preserve of a matted appearance should have a slight coat of parchment size, which will prevent the gold from rubbing off. The size should be warm, but not hot, and its strength half as great as that used with the colouring yellow.

The parts to which it is desired to give a more brilliant appearance are burnished with a burnisher made of wolves' or dogs' teeth, or agate, mounted in iron or wooden handles, which must be kept, throughout the process, perfectly dry. The operation of burnishing is very simple. Take hold of the tool near to the tooth or stone, and lean very hard with it on those parts which are to be burnished, causing it to glide by a backward and forward movement, without once taking it off the piece. When it is requisite that the hand should pass

over a large surface at once, without losing its point of support on the work-bench, the workman, on taking hold of the burnisher, should place it just underneath his little finger; by this means the work is done quicker, and the tool is more solidly fixed in the hand.

It will sometimes happen in gilding that small spots on the deeper parts are overlooked, or that the gold is removed in some parts in applying the matting size. When this is the case, small pieces of leaf gold are to be put on by means of a pencil, after moistening the deficient places with a small brush; when dry, each of these spots should be covered with a little size.

When it is desired to give the work the appearance of *or moulu*, dip a small fine pencil into the vermilioning composition, and apply it delicately into the indentations and such other parts, where it will, by being reflected, give a good effect to the gold.

To bind and finish the work well, a second coat of the matting size should be passed over the matted parts, and hotter than the first.

Gilding Plaster or Marble with Water Size.

The chief difference to be observed when plaster or marble has to be gilt instead of wood, is to exclude the salt from the composition of the preparatory size, as in damp situations this would produce a white efflorescence upon the surface of the gold. Two coats of this size should be laid on; the first weak, that it may sink into the plaster or marble and moisten it perfectly; the second, strong.

Gilding Wood in Oil.

The wood must first be covered, or primed, with two or three coatings of boiled linseed oil and carbonate of lead; and, when dry, a thin coating of gold oil size laid upon it. In about twelve hours this sizing, if good, will be dry, when you may begin to apply the gold-leaf, dividing it, and laying it on in the same manner as in the case of the water-gilding; with this difference, that it is to be gently pressed down with a ball of soft cotton, when it will instantly adhere so firmly to the size, that, after a few minutes, the gentle application of a large camel's-hair brush will sweep away all the loose particles of the leaf without disturbing the rest.

The advantages of this oil-gilding are, that it is easily and quickly done, is very durable, is not readily injured by changes of weather, even when exposed to the open air, and, when soiled, may be cleaned by a little warm water and a soft brush. It cannot, however, be burnished, and is, therefore, deficient in lustre.

To gild Steel.

Pour some of the ethereal solution of gold into a wine-glass, and dip into it the blade of a new penknife, lancet, or razor; withdraw the instrument, and allow the ether to evaporate: the blade will then be found covered with a beautiful coat of gold. The blade may be moistened with a clean rag or a small piece of very dry sponge

dipped into the ether, and the same effect will be produced.

To gild Copper, Brass, &c.

The gilding of these inferior metals and alloys of them is effected by the assistance of mercury, with which the gold is amalgamated. The mercury is evaporated, while the gold is fixed, by the application of heat; the whole is then burnished, or left mat, in whole or in part, according as required.

In the large way of gilding, the furnaces are so contrived that the volatilized mercury is again condensed, and preserved for further use, so that there is no loss in the operation. There is also a contrivance by which the volatile particles of mercury are prevented from injuring the gilders.

Gilding Glass and Porcelain

Dissolve in boiled linseed oil an equal weight either of copal or amber, and add as much oil of turpentine as will enable you to apply the compound or size thus formed, as thin as possible, to the parts of the glass intended to be gilt. The glass is to be placed in a stove till it is so warm as almost to burn the fingers when handled. At this temperature the size becomes adhesive, and a piece of leaf gold, applied in the usual way, will immediately stick. Sweep off the superfluous portions of the leaf; and when quite cold it may be burnished,

taking care to interpose a piece of India paper between the gold and the burnisher.

It sometimes happens, when the varnish is not very good, that by repeated washing the gold wears off; on this account the practice of burning it in is sometimes had recourse to. For this purpose, some gold-powder is ground with borax, and in this state applied to the clean surface of the glass by a camel's-hair pencil; when quite dry, the glass is put into a stove, heated to about the temperature of an annealing oven; the gum burns off, and the borax, by vitrifying, cements the gold with great firmness to the glass; after which it may be burnished.

The gilding upon porcelain is in like manner fixed by heat and the use of borax; and this kind of ware, being neither transparent nor liable to soften, and thus to be injured in its form in a low red heat, is free from the risk and injury which the finer and more fusible kinds of glass are apt to sustain from such treatment. Porcelain and other wares may be platinized, silvered, tinned, or bronzed, in a similar manner.

Gilding Leather.

In order to impress gilt figures, letters, and other marks upon leather, as on the covers of books, edgings for doors, &c., the leather must first be dusted over with very finely-powdered yellow resin, or mastic gum. The iron tools, or stamps, are then arranged on a rack before a clear fire, so as to be well heated, without becoming

red hot. If the tools are *letters*, they have an alphabetical arrangement on the rack. Each letter or stamp must be tried as to its heat, by imprinting its mark on the raw side of a piece of waste leather. A little practice will enable the workman to judge of the heat. The tool is now to be pressed downwards on the gold leaf, which will, of course, be indented and show the figure imprinted on it. The next letter or stamp is now to be taken and stamped in like manner, and so on with the others; taking care to keep the letters in an even line with each other, like those in a book. By this operation the resin is melted; consequently the gold adheres to the leather. The superfluous gold may then be rubbed off by a cloth, the gilded impressions remaining on the leather. In this, as in every other operation, adroitness is acquired by practice.

The cloth alluded to should be slightly greasy to retain the gold wiped off; (otherwise there will be a great waste in a few months;) the cloth will thus be soon completely saturated or loaded with the gold. When this is the case, these cloths are generally sold to the refiners, who burn them and recover the gold. Some of these afford so much gold by burning as to be worth from a guinea to a guinea and a half.

Gilding Writings, Drawings, &c., on Paper or Parchment.

Letters written on vellum or paper are gilded in three ways. In the first, a little size is mixed with the ink,

and the letters are written as usual; when they are dry, a slight degree of stickiness is produced by breathing on them, upon which the gold leaf is immediately applied, and by a little pressure may be made to adhere with sufficient firmness. In the second method, some white lead or chalk is ground up with strong size, and the letters are made with this by means of a brush. When the mixture is almost dry, the gold leaf may be laid on, and afterwards burnished. The third method is to mix up some gold powder with size, and to form the letters of this by means of a brush.

Gilding the Edges of Paper.

The edges of the leaves of books and letter paper are gilded whilst in a horizontal position in the bookbinder's press, by first applying a composition formed of four parts of Armenian bole and one of candied sugar, ground together with water to a proper consistence and laid on by a brush with the white of an egg. This coating, when nearly dry, is smoothed by the burnisher. It is then slightly moistened by a sponge dipped in clean water, and squeezed in the hand. The gold leaf is now taken upon a piece of cotton, from the leathern cushion, and applied on the moistened surface. When dry, it is to be burnished by rubbing the burnisher over it repeatedly from end to end, taking care not to wound the surface by the point.

Oil Gold on Wood.

As previously stated, the gilding on wood, called oil gold, cannot be burnished and is always of the natural color of unwrought gold. It is often used for parts of furniture and mouldings of rooms, and as it

stands the weather, it is also employed for outside work. The surface to be gilded must first be rubbed smooth with shave grass. After this apply a priming of glue size and two coats of oil paint and one of flatting. To enrich the color of the gold, these last may be laid down in red or yellow. White, however, is usually preferred, as the darker color renders any imperfection in the gold-sizing more difficult to detect. When the last coat of paint is thoroughly dry, rub it over with wash-leather to render it smooth and free from dust and grit. If any patterns or figures are to be left ungilded, they should be slightly pounced over with white to prevent the gold leaf adhering to them. Another way is to paint them over with white of egg, which, if too thick, may be reduced with a little water. The following method has also been recommended: Take a white potato, slice it smooth and level with a sharp knife, and rub it over the surface before the sizing has been applied, then apply the gold leaf. A wet sponge will remove the surplus leaf without any trouble.

When all is ready for sizing, strain sufficient size through muslin, and put some out on the palette, adding to it enough ochre or vermilion, mixing with oil alone, to color. Then with a stiff hog-hair tool commence painting it on the surface, taking care to lay it on smoothly and not too thick, as in the latter case it runs and leaves wrinkles in the gilding. Size always from left to right, beginning on the top of the surface, and working downward. Move the brush lightly and firmly, mapping out the surface to be sized into several squares, and finishing and cross-hatching each before proceeding onwards. If there are patterns to be left ungilded, carefully trace round their outline with

a sable pencil and then fill in the interstices. When the whole surface is covered with size, give it a thorough inspection to make sure there is no faulty portion, and if there is, delicately touch in the size with a small pencil. When very perfect gilding is required it should be sized twice, the first being allowed to dry thoroughly before the second is applied. In carved work be careful to dip the brush down in the hollows of the carving. It is a good plan to size overnight so as to gild in the morning. But all size does not dry alike, sometimes taking 12 to 24 or 30 hours before it is ready for the gold leaf; in damp weather or moist locations always more than in dry. The readiness of the size can only be ascertained by the touch. If on being touched by the finger the surface daubs or comes off, it is not ready; but if it feels clammy and sticky, it is sufficiently dry. If too dry, it must be sized again. The books of gold leaf should always be placed before a fire half an hour previous to use, in order to dry the gold and make it more manageable. When all is ready, shake out several leaves upon the gold cushion and blow them towards the parchment screen. Then carefully raise one leaf with the blade of a knife and place it on the cushion, gently breathing on it to flatten it out. If it curls up, work it about with the knife-blade until it lies flat. Then replace the knife in its loop under the cushion, and taking the tip pass it lightly over your hair, thus acquiring sufficient greasiness to enable the gold to stick to it. Lay the hairy portion of the tip upon the gold leaf, and then raising it apply it to the sized surface. As in sizing, work from left to right, and be especially careful to let each leaf overlap slightly, so as to avoid gaps and spaces. Lay on whole leaves as far as the space per-

mits, and then proceed to gild the curves and corners which need smaller pieces. Place a leaf flat and smooth on the cushion, and then taking the knife in the right hand draw the edge easily and evenly along it with a gentle pressure. Divide the leaf into as many pieces as required and lay on as before. When all the ground is complete, inspect it carefully to make sure that there are no portions ungilt, however small, and mend them at once. Next take a piece of cotton-wool and gently dab or press the gold down all over, finally brushing off the superfluous pieces either with cotton-wool or a camel's hair brush. It is a good plan to stipple the gold with a large, stiff hog-bristle tool, quite dry and clean, as this gradually softens and removes the marks of joining and other little imperfections. Finally smooth the gold with a clean piece of wash-leather, and it is completed.

With regard to gilding with japanner's size the same instructions apply, except as to the time necessary to wait between sizing and gilding. If japanner's size is used pure, it will be ready in from 20 to 30 minutes, but better gilding can be made by mixing one-third oil size with two-thirds of japanner's size. This will be ready in about 2 to 4 hours from the time of putting on. When all the gilding is finished, dilute 1 part of very clean and pure parchment size with 2 parts of water, and brush it over the entire surface of the gold to enrich and preserve it. If it is necessary to gild in a position much exposed to touch, as the base of a pillar or string-course, it is as well to give the gold a coat of mastic varnish thinned with turpentine. There are various processes which tend to enrich and vary the effect of gilding. Glazings of transparent colors are sometimes applied for the purpose of dead-

ening its lustre. Raw sienna passed thinly over a sheet of gold gives it a leathery appearance. A good effect may be produced by stencilling a small pattern in umber, sienna, or Indian red over gold, especially if there is foliage, or arabesque work upon the gilding, as the small design affords an agreeable relief. This is the easiest mode of gilding; any other metallic leaves can be applied in a similar manner.

Gilding on Wood in the Open Air.

First get a good surface, then put on the size. Fat oil is the best size for outside work. Tint the size with chrome yellow, finely ground, and thin with oil of turpentine until it works well. If the work is to be done in a hurry, a little japan may be added to the size to make it dry faster. Wait until it dries tacky. It is important to get the right tack on your size. If too dry the leaf will not adhere well; if not dry enough the work will look shabby and rub up under the finger. If pressed for time varnish may be used for sizing, instead of fat oil. It dries faster, and care must be taken not to size too far ahead, otherwise the "tack" may dry out before it can be all covered. Now to handle the leaf: Go into a quiet room, lay the book of leaf on a table, with the back of the book toward you, carefully turn back the first paper, then with the first finger of the left hand hold down the left-hand corner of the book next to you, and tear off the paper by pulling to the right. Now, lay the paper flat on your hand, and rub it over your hair, from which it will take oil enough to make the leaf adhere to it. Now, lay the paper carefully down upon the leaf, and rub it down with your fingers to make the leaf stick to it, then you can use it whole for gilding

large surfaces, or cut it up with shears in any shape you want it. If the leaf does not adhere well to the paper, your hair either does not afford enough oil, or you have not rubbed hard enough. If you find your hair will not make it adhere, rub your hands over a bar of hard soap and rub them well through the hair; then by rubbing the paper over it the leaf will stick to the paper. Prepare in this way all the leaf you think you will need, and after carefully placing it in a box or basket you are ready to go out and lay it on. Then all you have to do is to lay your paper on the size, leaf side down, rub it down with your fingers and then pull off the paper. Any spot not covered can be mended by holding a strip of paper over it, and pressing down with the thumb or finger. If the paper in the book is colored so that it will color the hair, it is best to cut up white paper of about the same texture, the size of the book, and use it instead of the paper in the book to take up the leaf on.

This is the best method for gilding on the outside when the air is stirring. Some gilders cut the binding of the book and loosen all the leaves at once, but in that way any little mishap is liable to get the book out of shape and ruin more or less of the leaf. There is a knack of taking the "kinks" out of a rumpled or turned-up leaf by a puff of the breath. The novice is apt to blow the leaf into an awful fix in his first attempts, but with practice he will find that a quite badly mussed leaf can be made tolerably smooth by a soft puff from the right direction—but it must be *soft*, or away will go the leaf into an irredeemable crumple.

Regilding Frames.

Wash the frame well with a sponge and clean water,

and let it dry. Then mix water gold size with enough parchment size to enable you to work it on the frame with a camel's hair brush. Apply two coats of it; when dry rub it over with a piece of fine sand-paper; it will then be ready for gilding. When the frame is covered rest it on its edge. When perfectly dry dip a pencil into water, and wipe the gold over with it. It will take the particles of gold off, and make it appear solid. For any parts not covered take bits of leaf with a dry pencil and lay on as before, then give the whole a coat of clear parchment size, brush the black edges over with ochre, and the frame is then ready.

To Gild Signs.

Use gold and silver leaf. Take a little fine isinglass, as much as will lie on a five-cent piece, and dissolve in a little boiling water. Add as much alcohol as there is water and strain through silk. Paint the letters on a sheet of paper with Brunswick black; fix the paper, with the writing reversed, on the glass. Use the isinglass solution as mordant, laying it on with a camel's hair pencil, and then apply the gold leaf. Place the glass in a warm room, and when the gilding is dry rub it over with a piece of cotton-wool. Pass a flat camel's hair brush moistened with the isinglass solution lightly over the gold letters, the solution being heated for this operation. A second coating of gold leaf will improve the work.

Gilding Glass.

Thoroughly clean the glass, then take some very weak isinglass size, heat it, and float the glass, where the gold is to be laid, with the warm size and a soft brush. Then lay the gold on with a gilder's tip, previously drawing it over the hair of your head to cause

the gold to adhere to it. Tilt the glass to allow the superfluous size to run away, then let it dry, and if it does not look sufficiently solid upon the face, give another layer of gold the same way. Where the black lines are to show, take a piece of pointed fire-wood, cut to the width the lines are needed, and with a straight-edge draw a line with the piece of wood which, if made true and smooth, will take the gold off clean, and so square and sharpen up all the edges, lines, etc. When this is done give a coat of Brunswick black thinned with a little oil of turpentine and the lines will show black, and it will preserve the gold. Try a small piece first, so as to get all in order.

To Repair Lustre Gilding.

Make a compound by melting Venice turpentine, white wax, and a little soap, over a moderate fire. Apply the mixture to the injured places with a brush. Let it remain for an hour, then lay on the gilding.

Gilding on Granite.

Apply a coat of size, and then, two or three coats of size and fine powdered whiting. Let each coat dry and rub down with fine glass paper before the next is applied. Then go over it thinly and evenly with gold size and apply the gold leaf.

To Gild Letters on Marble.

First apply a coating of size, then successively several coats of size thickened with whiting, until a good face is produced. Let each coat dry and rub it down with fine glass paper before applying the next. Then go over the marble thinly and evenly with gold size. Apply the gold leaf and burnish with an agate. The gold leaf must be applied several times to give a good effect.

FOILS.

Foils are thin plates or leaves of metal that are put under stones, or compositions in imitation of stones, when they are set, either to increase the lustre and play of the stones, or more generally to improve the colour, by giving an additional force to the tinge, whether it be natural or artificial, by a ground of the same hue.

There are two kinds of foils. One is colourless, where the effect of giving lustre to the stone is produced by the polish of the surface, making it act as a mirror, and, by reflecting the light, preventing the deadness which attends a duller ground under the stone, and bringing it nearer to the effect of the diamond. The other is coloured with some pigment or stain, either of the same hue as the stone, or of some other, which is intended to change the hue of the stone in some degree; thus, a yellow foil may be put under green which is too much inclined to blue, or under crimson, where it is desired to have the appearance of orange or scarlet.

Foils may be made of copper or tin. Silver has been sometimes used, and even gold mixed with it; but the expense of either is needless, as copper may be made to answer the same end.

Copper intended for foils is prepared by taking copper plates beaten to a proper thickness, passing them betwixt a pair of fine steel rollers very closely set, and

drawing them as thin as possible. They are polished with very fine whiting, or rotten-stone, till they shine, and have as much brightness as can be given them, and then they will be fit to receive the colour. If they are intended for a purple or crimson colour, the foils should first be whitened in the following manner: Take a small quantity of silver, and dissolve it in *aqua-fortis*; then put bits of copper into the solution, and precipitate the silver; which being done, the fluid must be poured off, and fresh water added to it to wash away all the remainder of the first fluid; after which the silver must be dried, and an equal weight of cream of tartar and common salt ground with it, till the whole is reduced to a very fine powder. With this mixture, the foils, slightly moistened, must be rubbed by the finger, or a bit of linen rag, till they are of the degree of whiteness desired.

The manner of preparing foils, so as to give colourless stones the greatest degree of play and lustre, by raising so high a polish or smoothness on the surface as in many instances to nearly resemble the effect of diamonds, I shall not here detail, as it is not one in which the general occupations of the Painter, Varnisher, or Gilder, would be of assistance. The method of colouring these substances I shall here describe.

To Colour Foils.

Two methods have been invented for colouring foils; the one by tinging the surface of the copper with the

colour required by means of smoke, the other by staining or painting it with some colouring substance.

The colours used for painting foils may be mixed with either oil, water rendered glutinous by gum-arabic, size, or varnish. Where deep colours are wanted, oil is most proper, because some pigments become wholly transparent in it, as lake or Prussian blue: the yellow and green may be better laid on in varnish, as these colours may be had in perfection from a tinge wholly dissolved in spirit of wine, in the same manner as in the case of lacquers; and the most beautiful green is to be produced by distilled verdigris, which is apt to lose its colour and turn black with oil. In common cases, however, any of the colours may be, with the least trouble, laid on with isinglass size, in the same manner as the glazing colours used in miniature painting.

Where the *ruby* is to be imitated, a little lake used in isinglass size, carmine, or shell-lac varnish, is to be employed, if the glass or paste be of a full crimson, verging towards the purple; but if the glass incline to the scarlet, or orange, very bright lake, not purple, may be used alone in oil.

For *garnet red*, dragon's blood dissolved in seed-lac varnish may be used; and for the *vinegar garnet*, the orange lake, tempered with shell-lac varnish, will be found excellent.

For the *amethyst*, lake, with a little Prussian blue, used with oil, and very thinly spread on the foil, will answer.

For *blue*, where a deep colour or sapphire is wanted,

Prussian blue, not too deep, should be used in oil, and be spread more or less thinly on the foil, according to the lightness or deepness of the colour required.

For *eagle marine*, common verdigris, with a little Prussian blue, tempered in shell-lac varnish.

Where a *full yellow* is desired, the foil may be coloured with a yellow lacquer, laid on as for other purposes. For *light yellows*, the copper ground of the foil itself, properly burnished, will be sufficient.

For *green*, where a deep hue is required, the crystals of verdigris, tempered in shell-lac varnish, should be used; but where the *emerald* is to be imitated, a little yellow lacquer should be added, to bring the colour to a truer green, and less verging to the blue.

The stones of more diluted colour, such as the *amethyst*, *topaz*, *vinegar garnet*, and *eagle marine*, may be very cheaply imitated by transparent white glass or paste, even without foils. This is to be done by tempering the colours above mentioned with turpentine and mastic, and painting the socket in which the counterfeit stone is to be set with the mixture, the socket and stone itself being previously heated. In this case, however, the stone should be immediately set, and the socket closed upon it before the mixture cools and grows hard. The orange lake, mentioned under the head of garnet red, was invented for this purpose, in which it has a beautiful effect, and has been used with great success. The colour it produces is that of the vinegar garnet, which it affords with great brightness.

The colours before directed to be used in oil should

be extremely well ground in oil of turpentine, and tempered with oil—nut or poppy oil; or, if time can be given for their drying, with strong fat oil, diluted with spirits of turpentine, which will gain a fine polish of itself. The colours used in varnish should be likewise thoroughly well ground and mixed; and in the case of dragon's blood in the seed-lac varnish and the lacquer, the foils should be warmed before they are laid out. All the mixtures should be laid on the foils with a broad soft brush, which must be passed from one end to the other, and no part should be crossed or twice gone over —or, at least, not till the first coat be dry; when, if the colour does not lie enough, a second coat may be given.

GLASS-STAINING.

In the production of figures on glass, fragments of coloured glass are used, which are cut in pieces of the proper shape, and united by lead. In this way are formed the ground tints, skies, draperies, ornaments, &c. The shades, heads, hands, &c., are then painted in vitrifiable colours, which, after being laid on, are burnt or fired into the glass. The precaution should be observed in joining the pieces of coloured glass, that the lead joints do not interfere with the effect of the picture. That which characterizes painting on glass, and distinguishes it from painting on porcelain, is that the artist makes use of both surfaces of the glass. The surface placed towards the spectator receives all the shades, which are thus rendered more life-like and better defined. All the shading colours are likewise placed on this side; all the lights of the picture are thrown on the other side. By this means colours may be used which would be injured by contact with each other, and the superposition of which would produce peculiar tints not desirable.

The pigments used in painting on glass are principally metallic oxides and chlorides, and as, in most of these, the colour is not brought out until after the painting is submitted to heat, it is necessary to ascertain beforehand if the colours are properly mixed, by painting on

slips of glass, and exposing them to heat in the muffle. The painter is guided by these trial pieces, in laying on his colours. As the effect of a picture on glass is produced by transmitted and not by reflected light, it is necessary that the colours, after being burnt on, should be more or less transparent.

As the coloured glass which forms the ground on which the artist works is manufactured in glass-works, and is an article of commerce, it is necessary to consider here only the colours which are burnt on in the muffle. The temperature at which these are burnt on is never raised above the melting point of silver.

In oil and water-colour paintings, the pigments are rubbed up with oil, solutions of gum, water, &c. In painting on glass, it is necessary to have a proper vehicle for the colours, which will become liquid at a red heat, and which performs the same function as oils, &c., in ordinary painting. This vehicle is called a *flux*. It envelops the colour which is mechanically mixed with it, and glues it, as it were, to the glass. The colour and the flux are often confounded, however, under the name of *vitrifiable colours*, which are mixtures of colour and flux. The vehicle or flux varies with colour, but these variations are very limited, as the colours ought to be capable of mixing with each other. The flux ordinarily employed is a simple silicate of lead, or a mixture of silicate of lead and borax. Experiment has shown that potash and soda cannot be substituted for borax. The following are the proportions of the ingredients of various fluxes :—

No. 1.

Minium or red lead	3 parts.
White sand washed	1 part.

This mixture is melted, by which it is converted into a greenish-yellow glass.

No. 2.—Gray Flux.

Of No. 1	8 parts.
Fused borax in powder	1 part.

This mixture is melted.

No. 3.—Flux for Carmines and Greens.

Fused borax	5 parts.
Calcined flint . . . . , .	3 parts.
Pure minium	1 part.

This mixture is also melted.

The various colors used in glass painting are obtained from the following substances:—

The *blue* on glass is produced with cobalt; the *purples*, *violets*, and *carmines*, with the purple of Cassius; the *reds*, *browns*, &c., with the peroxide of iron; the *greens* with the silicate of copper, sometimes with the oxide of chromium, (in glass-painting, greens of copper are preferred to those of chromium, on account of their greater transparency,) often with a mixture of blue and yellow; the *blacks*, *grays*, &c., with the oxides of manganese,

cobalt, and iron; the *yellows* with the oxide of uranium, the chromate of lead, certain combinations of silver; finally, the compounds of antimonious acid, and of oxide of lead, or of the subsulphate of iron.

Beautiful yellow tones may be produced on glass by placing on its surface a layer of three parts of pipe-clay, well burnt and pounded, and rubbed up with one part of chloride of silver. The glass is then submitted to heat in a muffle. After cooling, the layer of clay is removed, and the glass is stained yellow. The tint depends on the nature of the glass and the proportion of chloride of silver. Glass, containing about eight or ten per cent. of alumina, takes a more beautiful tint than glass containing only two or three per cent.

The following are some of the colours used in the celebrated porcelain manufactory of Sevres, and the proportions in which they are compounded. These colours, though intended for painting on porcelain, are nearly all applicable to painting on glass.

BLUES are obtained with the silicate of cobalt. The oxide of cobalt must be in the state of silicate, in order that the blue colour be developed. The colour, once produced, is unalterable at all temperatures.

No. 1.—Indigo Blue.

Oxide of cobalt	1 part.
Flux No. 3	2 parts.

No. 2.—*Turquoise Blue.*

Oxide of cobalt	1 part.
Oxide of zinc . . .	3 or 4 parts.
Flux No. 3	6 "

Melt and pour out. If it is not sufficiently green, increase the zinc and flux.

No. 3.—*Azure Blue.*

Oxide of cobalt	1 part.
Oxide of zinc	2 parts
Flux No. 2	8 "

Melt them together.

No. 4.—*Deep Azure Blue.*

Oxide of cobalt	1 part.
Oxide of zinc	2 parts.
Flux No. 2	5 "

The beauty of this colour depends on the proportion of flux. As little as possible is to be used; it must, however, be brilliant. Sometimes less is used than the proportion indicated.

No. 5.—*Sky Blue, for the Browns.*

Oxide of cobalt	1 part.
Oxide of zinc	2 parts.
Flux No. 2	12 "

Pound up, melt, and pour out.

No 6.—Violet Blue, for ground colour.

Blue No. 5	4 parts.
Violet of gold, No. 31 . .	2 "

More or less of the violet of gold is added. Triturate without melting.

No. 7.—Lavender Blue, for ground tint.

Blue No. 5	4 parts.
Violet of gold, No. 31 . .	3 "

Sometimes a little carmine is added. Pulverize without melting.

Greens are obtained with the oxide of chromium, or with the deutoxide of copper, or with mixtures of oxide of chromium and silicate of cobalt, when bluish tones are wished. When these greens contain the oxide of copper, they require a previous fusion, for it is only in the state of silicate or of salt that this oxide gives a green. The greens of copper disappear entirely at a high heat.

When the colours are required to be transparent, the oxide of copper is used instead of the oxide of chromium.

No. 8.—Emerald Green.

Oxide of copper	1 part.
Antimonic acid	10 parts.
Flux No. 1 . . .	30 "

Pulverize together, and melt.

No. 9.—*Bluish Green.*

Green oxide of chromium . .	1 part.
Oxide of cobalt	2 parts.

Triturate, and melt at a high heat. The product is a button slightly melted, from which is removed the portion in contact with the crucible. This button is pounded up, and three parts of flux No. 3, for one of the button. are added to it.

No. 10.—*Grass Green.*

Green oxide of chromium . .	1 part.
Flux No. 3	3 parts.

Triturate, and melt.

Nos. 10, 11, 12.—*Dragon, Pistache, and Olive Green.*

They are prepared with the oxide of chromium, mixed with flux No. 3, with additions of deep or clear yellow No. 15 or 16, ascertaining the proportions by trial.

YELLOWS are commonly obtained by means of antimonic acid and the oxide of lead, (litharge.) It is the Naples yellow, or very nearly so. Sometimes stannic acid (peroxide of tin) is added, and oxide of zinc, and often also some subsulphate of the peroxide of iron, prepared by exposing to the air weak solutions of the protosulphate of iron, (copperas.)

These colours do not change in the muffle, but they disappear almost entirely at a high heat. They are

easily altered by smoke, by which the oxide of lead is reduced, which produces a dirty gray.

Yellows are made with the chromate of lead, but their use is too uncertain. In Germany, the oxide of uranium is employed, which gives a beautiful yellow; but in France it is found to produce no better yellow than those already known.

No. 13.—*Sulphur Yellow.*

Antimonic acid	1 part.
Subsulphate of the peroxide of iron	8 parts.
Oxide of zinc	4 "
Flux No. 1	36 "

Rub up together, and melt; if this colour is too deep, the salt of iron is diminished.

No. 14.—*Fixed Yellow for touches.*

Yellow No. 13	1 part.
White enamel of commerce .	2 parts.

Melt, and pour out. If it is not sufficiently fixed, a little sand may be added.

No. 15.—*Yellow for Browns and Greens.*

Antimonic acid	2 parts.
Subsulphate of iron . . .	1 part.
Flux No. 1	9 parts.

This colour is melted, and sometimes a little Naples yellow is added if it is too soft, (*i. e.* melts too easily.)

No. 16.—*Deep Yellow, to mix with the Chromium Greens.*

Antimonic acid	2 parts.
Subsulphate of iron . .	1 part.
Flux No. 1	10 parts.

Melt, and pour out. The subsulphate of iron may be increased a little: the proportions of flux vary.

No. 17.—*Jonquille Yellow for flowers.*

Litharge	18 parts.
Sand	6 "
The product of the calcination of equal parts of lead and tin .	2 "
Carbonate of soda . . .	1 part.
Antimonic acid . . .	1 "

Rub together or triturate, and melt.

No. 18.—*Wax Yellow.*

Litharge	18 parts.
Sand	4 "
Oxide of antimony . . .	2 "
Sienna earth . . .	2 "

Melt. If it is too deep, the proportion of Sienna earth may be decreased.

No. 19.—*Fixed Wax Yellow.*

No. 18 mixed, without melting, with white enamel or sand, in order to harden it. The quantity depends on the greater or less fusibility of the yellow.

No. 20.—Nankin Yellow for grounds.

Subsulphate of iron	. . .	1 part.
Oxide of zinc	. . .	2 parts.
Flux No. 1	. . . .	10 "

Triturate.

No. 21.—Deep Nankin Yellow.

Subsulphate of iron	. . .	1 part.
Oxide of zinc	. . .	2 parts.
Flux No. 2	. . . .	8 "

Triturate without melting.

No. 22.—Pale Yellow Ochre.

Subsulphate of iron	. . .	1 part.
Oxide of zinc	. . .	2 parts.
Flux No. 2	. . . .	6 "

Triturate without melting.

No. 23.—Deep Yellow Ochre, called Yellow Brown.

Subsulphate of iron	. . .	1 part.
Oxide of zinc	. . .	1 "
Flux No. 2	. . . .	5 parts.

Triturate without melting.

No. 24.—Brown Yellow Ochre.

Yellow ochre, No. 23	. .	10 parts.
Sienna earth	. . .	1 part.

Mix without melting.

No. 25.—Isabella Yellow, for grounds.

Yellow for browns, No. 15 .	20 parts.
Blood red, No. 28 . . .	1 part.

No. 26.—Orange Yellow, for grounds.

Chromate of lead . . .	1 part.
Minium	3 parts.

No. 27.—Brick Red.

Yellow No. 23	12 parts.
Red oxide of iron . . .	1 part.

No. 28.—Deep Blood Red.

Subsulphate of iron, calcined in a muffle until it becomes a beautiful capucine red . . .	1 part.
Flux No. 2	3 parts.

Mix without melting.

Colours of Gold.—These are carmine reds, purples, and violets, made by means of the precipitated purple of Cassius. These colours are very delicate, and are the only ones which change their tints in the fire. Unburnt, they are of dirty violet tint, but are changed into a lively and pure tone by a moderate burning. In a stronger fire, these colours become yellowish, and even completely disappear. It is necessary to mix the purple of Cassius with considerable flux, and this mixture must

be made while the purple precipitate is still moist. If it was suffered to dry, the colour would be spoiled. With one part of purple of Cassius, six parts of flux are mixed. The purple powder of Cassius gives a purple by itself. Mixed with chloride of silver, which gives to it a yellow, a carmine tone is produced. With a little cobalt blue, it is rendered violet.

No. 29.—*Hard Carmine.*

It is the purple of Cassius mixed with flux No. 3, and chloride of silver, previously melted with ten parts of flux No. 3. The proportions vary. The whole is ground on a glass, the precipitate of gold being still moist.

No. 30.—*Pure Purple.*

The purple powder of Cassius mixed while moist with flux No. 3, and sometimes a little chloride of silver previously melted with flux No. 3. If the purple, when prepared, does not melt sufficiently easy, some flux may be added when it is dry.

No. 31.—*Deep Violet.*

The purple of Cassius; in place of flux No. 3, flux No. 1 is mixed with it. Sometimes a little of blue No. 6 is added.

Colours of Iron.—Besides the subsulphate of the peroxide, the peroxide itself is employed to produce rose tints, reds, violet tones, and browns. The pure peroxide

can produce the first three tones, and it is easily imagined when we know that its shade varies from rose to deep violet, according to the temperature to which it has been submitted. Slightly heated, it is rose or red; at a forge heat, it becomes violet. As to the browns of iron, they require some mixtures. These colours are unalterable in the muffle, but they disappear in great part at a high heat. In the first case the oxide remains free, and in the second it is united with the silica. A too fusible flux or glass produces the same effect.

No. 32.—*Flesh Red.*

The sulphate of iron, put in small crucibles and lightly calcined, produces a suitable red oxide. Those which have the desired tone are selected. All the flesh reds are made in this way, and vary only in the degrees of heat which they receive.

Browns may be obtained with various mixtures of peroxide or subsulphate of iron with the oxide of manganese, silicate of cobalt, or silicate of copper. These colours, unalterable in the heat of the muffle, lose their intensity at a high heat.

No. 33.—*Clove Brown.*

The basis of this brown is yellow ochre No. 23, to which is added either the oxide of cobalt *in small quantities*, or umber or sienna earth. Proportions are tried according to the tone required.

No. 34.—*Wood Brown.*

The same process as the clove brown, only without the oxide of cobalt.

No. 35.—*Hair Brown.*

Yellow ochre, No. 23	. .	15 parts.
Oxide of cobalt	. . . .	1 part.

Well triturated and calcined, in order to give the tone to it.

No. 36.—*Liver Brown.*

Oxide of iron made of a red brown, and mixed with three times its weight of flux No. 2. A tenth of sienna earth is added to it, if it is not sufficiently deep.

No. 37.—*Sepia Brown.*

Deep yellow ochre	. . .	15 parts.
Oxide of cobalt	. . . .	1 part.

A little manganese is added if it is not sufficiently deep. All the ingredients are well mixed, and calcined in order to produce the tone.

No. 38.—*White.*

The white enamel of commerce in cakes.

No. 39.

Another white is prepared by mixing equal parts of fluxes No. 1 and No. 3.

No. 40.—*Yellowish-Gray for Browns and Reds.*

Yellow, No. 15	1 part.
Blue, No. 5	1 "
Oxide of zinc	2 or 3 parts.
Flux, No. 2	5 "

Sometimes a little black is added, according to the tone which the mixture produces. The proportions of the blue and yellow vary.

No. 41.—*Bluish-Gray for Mixtures.*

Blue previously made by melting together three parts of flux No. 1, and one part of the mixture of	
Oxide of cobalt	8 parts.
Oxide of zinc	1 part.
Sulphate of iron calcined at a forge heat	1 "
Flux, No. 2	3 parts.

Triturate, and add a little manganese in order to render it more gray.

No. 42.—*Grayish-black for Mixtures.*

Yellow ochre, No. 23 . . .	15 parts.
Oxide of Cobalt	1 part.

Triturate and calcine in a crucible until it has the desired tone. A little oxide of manganese is added in order to make it blacker; sometimes a little more of oxide of cobalt.

No. 43.—Deep Black.

Oxide of cobalt . . .	2 parts.
" " copper	2 "
" " manganese . . .	1 "
Flux, No. 1.	6 "
Fused borax . . .	½ part.
Melt, and add	
Oxide of manganese . .	1 "
" " copper . .	2 parts.

Triturate without melting.

The colours thus prepared, after having been rubbed up on a plate of ground glass with the spirits of turpentine or lavender, thickened in the air, are applied with a hair pencil. Before using them, however, it is necessary to try them on small pieces of glass, and expose them to the fire, to ascertain if the desired tone of colour is produced. The artist must be guided by these proof pieces in using his colours. The proper glass for receiving these colours should be uniform, colourless, and difficult of fusion. For this reason, crown glass made with a little alkali or kelp is preferred.

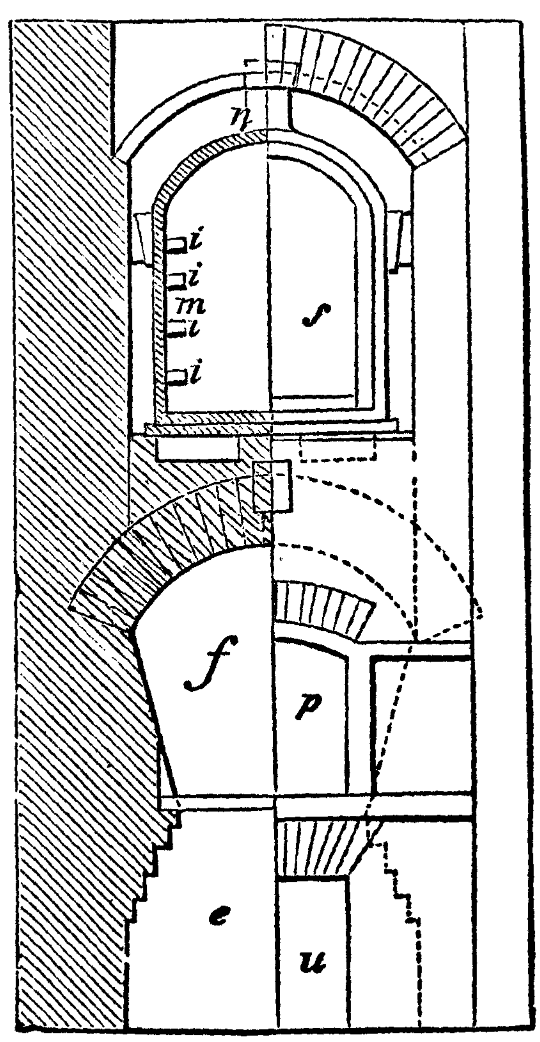
A design must be drawn upon paper, and placed beneath the plate of glass; though the artist cannot regulate his tints directly by his palette, but by specimens of the colours producible from his palette pigments after they are fired. The upper side of the glass being sponged over with gum-water, affords, when dry, a surface proper

for receiving the colours, without the risk of their running irregularly, as they would be apt to do on the slippery glass. The artist first draws on the plate, with a fine pencil, all the traces which mark the great outlines and shades of the figures. This is usually done in black, or at least some strong colour, such as brown, blue, green, or red. In laying on these, the painter is guided by the same principles as the engraver, when he produces the effect of light and shade, by dots, lines, or hatches; and he employs that colour to produce the shades which will harmonize best with the colour which is afterwards to be applied; but for the deeper shades, black is in general used. When this is finished, the whole picture will be represented in lines or hatches similar to an engraving, finished up to the highest effect possible; and afterwards, when it is dry, the vitrifying colours are laid on by means of larger hair pencils; their selection being regulated by the burnt specimen tints. When he finds it necessary to lay two colours adjoining, which are apt to run together in the muffle, he must apply one of them to the back of the glass. The yellow formed with chloride of silver is generally laid on the back of the glass. After colouring, the artist proceeds to bring out the lighter effects by taking off the colour in the proper place, with a goosequill cut like a pen without a slit. By working this upon the glass, he removes the colour from the parts where the lights should be the strongest; such as the hair, eyes, the reflection of bright surfaces and light parts of draperies.

The blank pen may be employed either to make the lights by lines, or hatches and dots, as is most suitable to the subject.

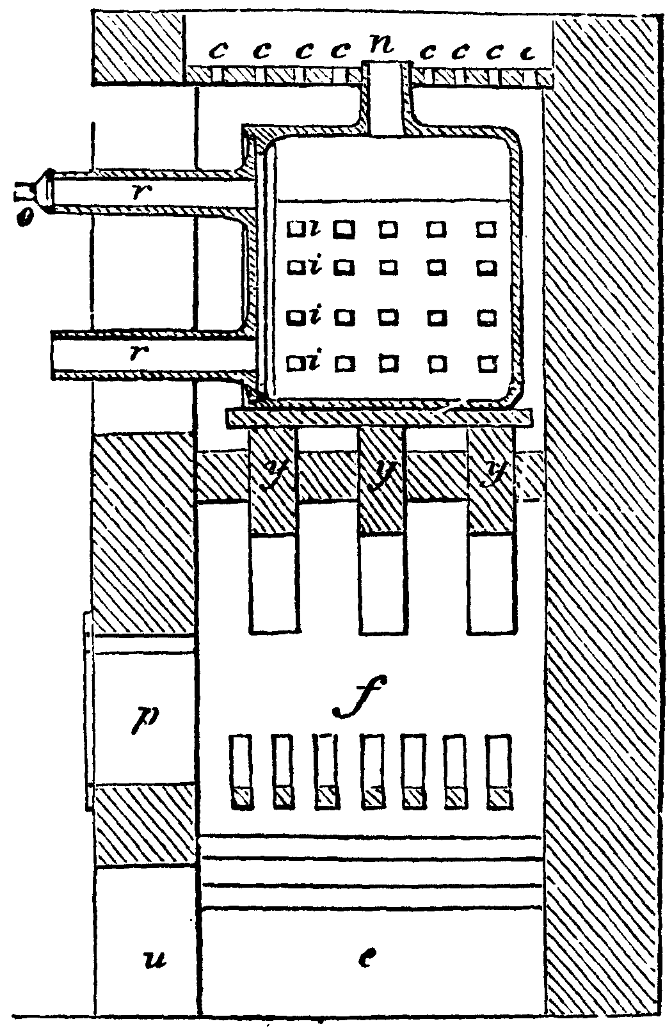
To fire the paintings, a furnace with a muffle is used. The muffles are made of refractory clay. They have been made of cast iron, but these are no longer employed. Fig. 6 is an elevation and transverse section of the fur-

Fig. 6.



nace, and its muffle in place. Fig. 7 is a longitudinal section. Figs. 8 and 9, views of the muffle; *u* is the

Fig. 7.



door of the ashpit *e*; *p* the door of the furnace *f*; *y*, *y*, are the small arches of the dome of the furnace which

Fig. 8.

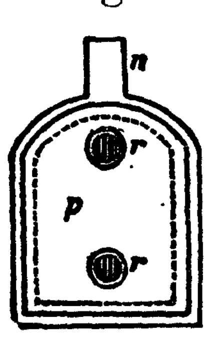
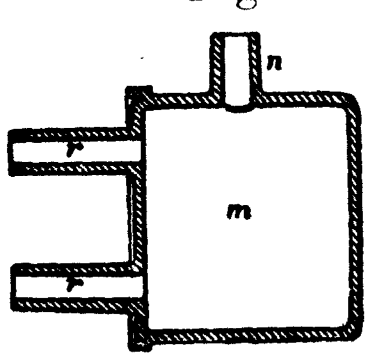


Fig. 9.



supports the muffle. *c, c* are the flues through which the flame escapes; *n* is a pipe or tube on the top of the muffle to allow vapours to escape; *r, r,* tubes in the door of the muffle, through which the proof pieces are passed. In the interior of the muffle, small brackets or projections *i, i* are placed, which support bars of iron encased in porcelain, on which the plates of glass which are to be burned rest. Dry pulverized lime is sometimes laid on the bottom of the muffle and the glass rested on the lime. Several layers of glass may be placed in the muffle together, with layers of lime between them. This is the better arrangement. As the paintings retain considerable oil, it is necessary, when the muffle is first charged, to heat gently, in order to volatilize or decompose this oil, leaving the muffle open. When the oil is driven off, the muffle is closed, and the fire increased. A greater or less intensity of heat is directed from one part to another of the muffle, by opening or closing the flues *c*, so as to cause the flames to pass over any point desired. The temperature suitable for burning is judged of by placing in the muffle pieces of glass painted with a little carmine. The heat should not be carried beyond the point at which the carmine is well developed. These pieces are fastened to iron wires, by which they may be passed in or out of the muffle through the tubes *r, r.* In this way the progress of the burning may be closely watched. When the carmine is well developed, the fire should be arrested, and the muffle allowed to cool. When the muffle has entirely cooled, the glass is withdrawn. If

any parts are defective, they may be retouched and put in the muffle a second time. Sufficient time should be allowed for the glass to become entirely cool, before withdrawing it.

FISH OIL AND ROSIN OIL PAINTS.

Various coarse paints, applicable to out-door work, and of great cheapness and durability, may be made with fish oil, according to the following processes:—

To prepare the Oil.

Into a cask which will contain about forty gallons, put thirty-two gallons of good common vinegar; add to this twelve pounds of litharge, and twelve pounds of white copperas in powder: bung up the vessel, and shake and roll it well twice a-day for a week, when it will be fit to put into a ton of whale, cod, or seal oil, (but the Southern whale oil is to be preferred, on account of its good colour and little or no smell:) shake and mix all together, when it may settle until the next day; then pour off the clear, which will be about seven-eighths of the whole. To clear this part, add twelve gallons of linseed oil, and two gallons of spirit of turpentine; shake them well together, and, after the whole has settled two or three days, it will be fit to grind white lead and all fine colours in; and, when ground, cannot be distinguished from those ground in linseed oil, unless by the superiority of colour.

If the oil be wanted only for coarse purposes, the linseed oil and oil of turpentine may be added at the same

time that the prepared vinegar is put in; and, after being well shaken up, is fit for immediate use, without being suffered to settle.

The residue or bottom, when settled by the addition of half its quantity of fresh lime-water, forms an excellent oil for mixing with all the coarse paints for preserving outside work.

All colours ground in the above oil, and used for inside work, must be thinned with linseed oil and oil of turpentine.

Gain by the above process.

One ton of fish oil, or 252 gallons . .	$151 20
32 gallons of vinegar, at 12½ cents per gallon .	4 00
12 lbs. litharge, at 7 cts. per lb. . .	84
12 lbs. white copperas, at 8 cts. ditto . .	96
12 gallons of linseed oil, at 90 cts. per gallon	10 80
2 gallons of spirit of turpentine, at 40 cts.	80
	$168 60

252 gallons of fish oil	
12 ditto linseed oil	
2 ditto spirit of turpentine	
32 ditto vinegar	
298 gallons, at 90 cts. per gallon	$268 20
Deduct the expense . .	168 60
	$99 60

Preparation and Cost of particular Colours.

I.—*Subdued Green.*

Fresh lime-water, 6 gallons	$	06
Road dirt, finely sifted, 112 pounds		10
Whiting, 112 ditto	1	12
Blue-black, 30 ditto	1	50
Wet blue, 20 ditto	4	00
Residue of the oil, 3 gallons	1	50
Yellow ochre in powder, 24 pounds	1	20
	$9	48

This composition will weigh three hundred and sixty-eight pounds, which is a little more than two and a half cents per pound. To render the above paint fit for use, to every eight pounds add one quart of the incorporated oil, and one quart of linseed oil, and it will be found a paint with every requisite quality, as well of beauty as of durability and cheapness, and in this state of preparation does not cost five cents per pound.

The following is the mode of mixing the ingredients:—

First pour six gallons of lime-water into a large tub, then throw in one hundred and twelve pounds of whiting; stir it round well with a stirrer, let it settle for about an hour, and stir it again. The painter may then put in the one hundred and twelve pounds of road dirt, mix it well, and add the blue-black, after which the

yellow ochre; and when all is tolerably blended, take it out of the tub, and put it on a large board or platform, and, with a labourer's shovel, mix and work it about as they do mortar. Now add the wet blue, which must be previously ground in the incorporated oil, (as it will not grind or mix with any other oil.) When this is added to the mass, you may begin to thin it with the incorporated oil, in the proportion of one quart to every eight pounds, and then the linseed oil in the same proportion, and it is ready to be put into casks for use.

II.—*Lead Colour.*

Whiting, 112 pounds	$1 12
Blue-back, 5 ditto	25
Lead ground in oil, 28 ditto	2 24
Road dirt, 56 ditto	10
Lime-water, 5 gallons	05
Residue of the oil, 2½ ditto	1 25
Weighs 256 pounds	$5 01

To the above add two gallons of the incorporated oil, and two gallons of linseed oil to thin it for use, and it will not exceed two cents and a quarter.

The lime-water, whiting, road dirt, and blue-black must be first mixed together; then add the ground lead, first blending it with two gallons and a half of the prepared fish oil; after which, thin the whole with the two gallons of linseed oil and two gallons of incorporated oil,

and it will be fit for use. For garden doors and other work liable to be in constant use, a little spirits of turpentine may be added to the paint whilst laying on, which will have the desired effect.

III.—*Bright Green.*

112	pounds yellow ochre in powder, at 5 cents per pound	$5 60
168	ditto road dust	25
112	ditto wet blue, at 20 cts. per pound .	22 40
10	ditto blue-black, at 5 cts. ditto . .	50
6	gallons of lime-water	06
4	ditto fish oil, prepared	2 40
7½	ditto incorporated oil	4 28
7½	ditto linseed oil, at 90 cts. per gallon .	6 75
592	pounds weight	$42 24

It will be seen that the bright green costs but about seven cents per pound, ready to lay on; and the inventor challenges any colourman or painter to produce a green equal to it for five times the price.

After painting, the colour left in the pot may be covered with water to prevent it from skinning, and the brushes, as usual, should be cleaned with the painting-knife and kept under water.

A brighter green may be formed by omitting the blue black.

A lighter green may be made by the addition of ten pounds of ground white lead.

A variety of greens may be obtained by varying the proportions of the blue and yellow.

Observe that the wet blue must be ground with the incorporated oil, preparatory to its being mixed with the mass.

IV.—*Stone Colour.*

Lime-water, 4 gallons	$ 04
Whiting, 112 pounds	1 12
White lead, ground, 28 pounds	2 24
Road dust, 56 pounds	10
Prepared fish oil, 2 gallons	1 20
Incorporated oil, 3½ gallons	2 00
Linseed oil, 3½ ditto	3 15
Weighs 293 pounds	$9 85

The above stone colour, fit for use, is not three and a half cents per pound.

V.—*Brown Red.*

Lime-water, 8 gallons	$ 08
Spanish brown, 112 pounds	3 36
Road dust, 224 pounds	40
4 gallons of fish oil	2 40
4 ditto incorporated oil	2 28
4 ditto linseed oil	3 60
Weighs 501 pounds	$12 12

This paint is scarcely two and a half cents per pound. The Spanish brown must be in powder.

VI.—A good *chocolate color* is made by the addition of blue-black, in powder, or lamp-black, till the color is to the painter's mind; and a lighter brown may be formed by adding ground white lead. By ground lead, is meant white lead ground in oil.

VII.—*Yellow* is prepared with yellow ochre in powder, in the same proportion as Spanish brown.

VIII.—*Black* is also prepared in the same proportion, using lamp-black or blue-black.

Rosin-oil Paints.

Rosin oil paints belong to the colors which contain a solid resin, a volatile oil and perhaps an addition of drying oil (linseed oil or varnish.) They are cheaper, but also less durable than oil paints, but are very useful for painting roofing paper, iron, zinc and brick work. The solid resin contained in the paint is colophony and the volatile solvent pinolin or rosin-spirit, which is obtained by subjecting colophony to dry distillation. The pinolin, as well as the rosin oil which is frequently used, is obtained as follows:

The still of a large distilling apparatus is filled three-quarters full with comminuted colophony. The manhole is then closed and luted with clay to prevent the escape of vapors. A slow fire is then started under the still to liquefy the colophony, and when this is the case, the fire is increased to decompose the colophony.

At the commencement of this decomposition water passes over first, and then a light oil—the pinolin or rosin spirit—which amounts to about 10 per cent. of

the colophony used. When this quantity has been obtained, distillation is interrupted and the receiver changed to catch the thick rosin oil. After this comes the thin rosin oil, each of these three products being caught separately. When the distillate passing over last shows a green fluorescence, the fire is removed from under the still and the residue remaining in the latter discharged.

We have now four products, viz.: Pinolin (rosin-spirit) with water, thick rosin oil, thin rosin oil, and residue. Of these the pinolin and thin rosin oil are used for rosin oil paints, the thick rosin oil for printing ink, and the residue for shoemaker's pitch and the manufacture of lampblack.

The pinolin is separated from the water by allowing it to stand quietly for a few days, and is then distilled over lime. The thin rosin oil can be immediately used.

Having thus prepared or acquired by purchase the raw materials for rosin-oil paints, the next step is the manufacture of the varnish, or rather the basis-mass which serves as the agglutinant for the pigments. The process is as follows:

Melt in a capacious boiler 6 parts colophony and 10 parts thin rosin-oil. When solution is complete add 18 parts pinolin, strain the liquid through linen, and when cold mix it with the pigments. *Or*, treat in the same manner, colophony 10 parts, thin rosin oil 6, good linseed oil varnish 4, pinolin 10, and oil of turpentine 8.

Receipts for Rosin-oil Paints.

The *figures* in the following formulæ refer to *parts by weight.*

White. White lead 25, barytes 10, rosin-oil basis-mass 20.

Gray. White lead 25, barytes 10, rosin-oil basis-mass 20, lampblack 2.

Brown. Umber 15, rosin-oil basis-mass 10.

Green. Chrome-green 15, rosin-oil basis-mass 6.

Yellow. French ochre 18, rosin-oil basis-mass 11.

Yellow-brown. French ochre 20, Venetian red 4, umber 4, rosin-oil basis-mass 12.

Tile red. Venetian red 20, barytes 10, rosin-oil basis-mass 16.

English red. Venetian red 20, rosin-oil basis-mass 13.

Blue. Zinc white 20, ultramarine 10, rosin-oil basis-mass 16.

All the above paints are ready for use, and cannot be otherwise furnished, since the determined quantity of oil of turpentine and pinolin have to be added warm to the agglutinant, and a subsequent addition might readily cause the decomposition of the paint.

In the composition of the varnish or basis-mass, slight modifications may be made according to the price obtained for the finished article; thus an addition of linseed oil, well-boiled and thick, much improves the paint, and, therefore, can be highly recommended, because the resin itself has little durability and the volatile constituents volatilize rapidly, so that a pure rosin-oil paint in a short time contains scarcely any agglutinant and is destroyed. Instead of rosin-oil, wood tar oil may also be used, the proper consistency of the paint being obtained by means of oil of turpentine or pinolin.

MISCELLANEOUS MATERIALS

Painter's Cream.

THIS is a preparation sometimes employed by painters when they are obliged to leave work unfinished for a length of time. They cover the parts already painted with it, which preserves the freshness of their colours, and can be easily removed when they return to their work. It is made as follows:—

Take half an ounce of the best mastic, finely powdered, and dissolve it over a gentle fire, in three ounces of very clear nut-oil. Pour the mixture into a marble mortar, with two drams of pounded sugar of lead at the bottom of it. Stir this with a wooden pestle, and keep adding water in small quantities till the whole is of the appearance and thickness of cream, and refuses to admit more water, so as to mix freely.

Rotten Stone.

Rotten Stone is sometimes harsh and gritty; the best way of trying it is to take a little between the teeth, when the least portion of grit may be detected. Careful workmen will always wash it before they use it. This is effected by stirring the fine powder in a considerable quantity of water, then allowing it to remain at rest for a few seconds, and pouring the water into a glazed

earthen vessel; the powder which then precipitates will be perfectly fine and smooth; by washing the remainder, the whole of the finer parts may be separated from the grit.

Glue and Isinglass.

Good glue should swell when kept in cold water for three or four days: it should be semi-transparent, of a brown color, and free from cloudiness. Before using it, it should be broken into small pieces, covered with cold water for some hours to soften it, then boiled till dissolved, and again allowed to congeal by cooling. The books in general recommend, as a size for gilding and bronzing, a solution of isinglass; but one of good clear common glue is much cheaper, and answers equally well. Isinglass, though a purer gelatine than glue, is not so easily dissolved.

Common Size.

Ordinary size is glue so much diluted with water that it does not harden in the mass, but preserves a jellified condition, and is thus sold in barrels. A better kind is however supplied, made into very thin square cakes like glue, which is principally used for sizing wood which has been stained, or for refined purposes. For distemper colors parchment size is the best, and is made as follows: Place a quantity of parchment cuttings in an iron kettle, cover them with water, and allow them to soak thoroughly. From 24 to 36 hours will be required for this purpose, and should the water have been absorbed, more must be added. The whole is then to be boiled for about six hours, during which the scum which rises must be removed. It is afterwards to be strained through a cloth. Size pre-

pared in the following manner will keep good for several weeks: Dissolve 3 or 4 ozs. of alum in boiling water and add the solution to a bucketful of the size. Boil and strain the size a second time and set in a cool place.

Size from glove leather. Steep $\frac{1}{2}$ lb. of cuttings of white glove leather in water for about 12 hours; then add about 6 quarts of water, and boil the whole down to 1 quart. Strain and allow to cool.

MISCELLANEOUS SUBJECTS

AND

USEFUL RECEIPTS.

THOUGH the whole of the following subjects and receipts cannot be strictly said to relate to the trades of the Painter, Gilder, or Varnisher, yet most of them are so intimately connected with them, and also so useful to him, that the present Manual could not be considered complete without their being introduced.

To increase the Strength of common Rectified Spirits of Wine, so as to make it equal to that of the best.

Take a pint of the common spirits, and put it into a bottle which it will only fill about three-quarters full. Add to it half an ounce of pearlash or salt of tartar, powdered as much as it can be without occasioning any great loss of its heat. Shake the mixture frequently for about half an hour, before which time a considerable sediment, like phlegm, will be separated from the spirits, and will appear along with the undissolved pearlash or

salt at the bottom of the bottle. Then pour the spirit off into another bottle, being careful to bring none of the sediment or salt along with it.* To the quantity just poured off add half an ounce of pearlash, powdered and heated as before, and repeat the same treatment. Continue to do this as often as you find necessary till you perceive little or no sediment: when this is the case, an ounce of alum, powdered and made hot, but not burned, must be put into the spirits, and suffered to remain some hours, the bottle being frequently shaken during the time; after which the spirit, when poured off, will be found free from all impurities, and equal to the best rectified spirits of wine.

To Silver by Heat.

Dissolve an ounce of pure silver in aqua fortis, and precipitate it with common salt; to which add half a pound of sal-ammoniac, sandever, and white vitriol, and a quarter of an ounce of sublimate.

Or dissolve an ounce of pure silver in aqua fortis, and precipitate it with common salt; and add, after washing, six ounces of common salt, three ounces each of sandever and white vitriol, and a quarter of an ounce of sublimate. These are to be ground into a paste, upon a fine stone with a muller; the substance to be silvered must be rubbed over with a sufficient quantity of the paste, and

* For this purpose, you had better use what is called a *separating funnel,* if you can procure it.

exposed to a proper degree of heat. When the silver runs, it is taken from the fire and dipped into weak spirits of salts to clean it.

To Tin Copper and Brass.

Boil six pounds of cream of tartar, four gallons of water, and eight pounds of grain tin or tin shavings. After the materials have boiled a sufficient time, the substance to be tinned is put therein, and the boiling continued, when the tin is precipitated in its metallic form.

To Tin Iron and Copper Vessels.

Iron which is to be tinned must be previously steeped in acid materials, such as sour whey, distiller's wash, &c.; then scoured and dipped in melted tin, having been first rubbed over with a solution of sal-ammoniac. The surface of the tin is prevented from calcining by covering it with a coat of fat. Copper vessels must be well cleansed; and then a sufficient quantity of tin with sal-ammoniac is put therein, and brought into fusion, and the copper vessel moved about. A little resin is sometimes added. The sal-ammoniac prevents the copper from scaling, and causes the tin to be fixed wherever it touches. Lately, zinc has been proposed for lining vessels instead of tin, to avoid the ill consequences which have been unjustly apprehended.

To paint Sail-Cloth, so as to make it Pliant, Durable, and Water-proof.

Grind ninety-six pounds of English ochre with boiled oil, and add to it sixteen pounds of black paint. Dissolve a pound of yellow soap in one pail of water on the fire, and mix it while hot with the paint. Lay this composition, without wetting it, upon the canvas, as stiff as can conveniently be done with the brush, so as to form a smooth surface; the next day, or the day after, (if the latter, so much the better,) lay on a second coat of ochre and black, with a very little, if any, soap; allow this coat a day to dry, and then finish the canvas with black paint.

To make Oil-Cloth.

The manner of making oil-cloth, or, as the vulgar sometimes term it, *oil-skin*, was at one period a mystery. The process is now well understood, and is equally simple and useful.

Dissolve some good resin or gum-lac over the fire in drying linseed oil, till the resin is dissolved, and the oil brought to the thickness of a balsam. If this be spread upon canvas, or any other linen cloth, so as fully to drench and entirely to glaze it over, the cloth, if then suffered to dry thoroughly, will be quite impenetrable to wet of every description *

* This preparation will likewise be found both useful and economical in securing timber from the effects of wet.

This varnish may either be worked by itself or with some colour added to it: as verdigris for a green; umber for a hair colour; white lead and lamp-black for a gray; indigo and white for a light blue, &c. To give the colour, you have only to grind it with the last coat of varnish you lay on. You must be as careful as possible to lay on the varnish equally in all parts.

A better method, however, of preparing oil-cloth is first to cover the cloth or canvas with a liquid paste, made with drying oil in the following manner: Take Spanish white or tobacco-pipe clay which has been completely cleaned by washing and sifting it from all impurities, and mix it up with boiled oil, to which a drying quality has been given by adding a dose of litharge one-fourth the weight of the oil. This mixture, being brought to the consistence of thin paste, is spread over the cloth or canvas by means of an iron spatula equal in length to the breadth of the cloth. When the first coating is dry, a second is applied. The unevennesses occasioned by the coarseness of the cloth or the unequal application of the paste are smoothed down with pumice-stone reduced to powder, and rubbed over the cloth with a bit of soft serge or cork dipped in water. When the last coating is dry, the cloth must be well washed in water to clean it; and, after it is dried, a varnish composed of gum-lac dissolved in linseed oil boiled with turpentine is applied to it, and the process is complete. The colour of the varnished cloth thus produced is yellow; but different tints can be given to it in the manner already pointed out.

An improved description of this article, intended for figured and printed varnished cloths, is obtained by using a finer paste, and cloth of a more delicate texture.

To prepare Varnished Silk.

Varnished silk, often employed for umbrellas, covering to hats, &c., being impenetrable to wet, is prepared, and the operation performed, in the same manner as I have described in the second method of preparing oil-cloth, but with a different kind of varnish or paste.

The paste used for silk is composed of linseed oil boiled with a fourth part of litharge; tobacco-pipe clay, dried and sifted, sixteen parts; litharge, ground on porphyry or very fine marble, and likewise dried and sifted, three parts; lamp-black one part. After the washing of the silk, fat copal varnish is applied instead of that used for oil-cloth.

To paint Cloth, Cambric, Sarcenet, &c., so as to render them Transparent.

Grind to a fine powder three pounds of clear white resin, and put it into two pounds of good nut oil, to which a strong drying quality has been given; set the mixture over a moderate fire, and keep stirring it till all the resin is dissolved; then put in two pounds of the best Venice turpentine, and keep stirring the whole well together; and, if the cloth or cambric be thoroughly varnished on both sides with this mixture, it will be quite transparent.

I should remark that in this operation, as well as in the preparation of oil-cloths and varnished silks, the surfaces upon which the varnish or paste is to be applied must be stretched tight, and made fast during the application.

This mode of rendering cloth, &c. transparent is excellently adapted for window-blinds. The varnish will likewise admit of any design in oil colours being executed upon it as a transparency.

To thicken Linen Cloths for Screens.

Grind whiting with flowers of zinc, and add a little honey to it; then take a soft brush, and lay it upon the cloth, repeating the operation two or three times, and giving it time to dry between the different coatings. For the last coat, smooth it over with linseed oil nearly boiling, and mixed with a small quantity of the litharge of gold—the better to enable the cloth to stand the weather.

Printers' Ink.

Printers' ink is a real black paint, composed of lamp-black, and linseed oil which has undergone a degree of heat superior to that of any of the common drying oils.

The manner of preparing it is extremely simple. Boil linseed oil in a large iron pot for eight hours, adding to it bits of toasted bread, for the purpose of absorbing the water contained in the oil. Let it rest till the following morning, and then expose it to the same degree

of heat for eight hours more, or till it has acquired the consistence required; then add lamp-black worked up with a mixture of oil of turpentine and turpentine.

The consistence depends on the degree of heat given to the oil, and the quantity of lamp-black mixed up with it; and this consistence is regulated by the strength of the paper for which the ink is intended.

The preparation of printers' ink should take place in the open air, to prevent the bad effects arising from the vapour of the burnt oil, and, in particular, to guard against accidents by fire.

Sticking, or Court Plaster.

This plaster is well known from its general use and its healing properties. It is merely a kind of varnished silk, and its manufacture is very easy.

Bruise a sufficient quantity of isinglass, and let it soak in a little warm water for four-and-twenty hours; expose it to heat over the fire till the greater part of the water is dissipated, and supply its place by proof spirits of wine, which will combine with the isinglass. Strain the whole through a piece of open linen, taking care that the consistence of the mixture shall be such that, when cool, it may form a trembling jelly.

Extend the piece of black silk, of which you propose making your plaster, on a wooden frame, and fix it in that position by means of tacks or pack-thread. Then apply the isinglass (after it has been rendered liquid by a gentle heat) to the silk with a brush of fine hair,

(badger's is the best.) As soon as this first coating is dried, which will not be long, apply a second; and afterwards, if you wish the article to be very superior, a third. When the whole is dry, cover it with two or three coatings of the balsam of Peru.

This is the genuine court plaster. It is pliable, and never breaks, which is far from being the case with many of the spurious articles which are sold under that name. Indeed, this commodity is very frequently adulterated. A kind of plaster, with a very thick and brittle covering, is often sold for it. The manufacturers of this, instead of isinglass, use common glue, which is much cheaper; and cover the whole with spirit varnish, instead of balsam of Peru. This plaster cracks, and has none of the balsamic smell by which the genuine court plaster is distinguished. Another method of detecting the adulteration is to moisten it with your tongue *on the side opposite to that which is varnished;* and, if the plaster be genuine, it will adhere exceedingly well. The adulterated plaster is too hard for this: it will not stick, unless you moisten it on the varnished side.

To imitate Tortoise-shell with Horn.

Mix up an equal quantity of quicklime and red lead with strong soap-lees; lay it on the horn with a small brush, in imitation of the mottle of tortoise-shell; when it is dry, repeat it two or three times.

Or, grind an ounce of litharge and half an ounce of quicklime together, with a sufficient quantity of liquid

salt of tartar to make it of the consistence of paint. Put it on the horn with a brush, in imitation of tortoise-shell, and in three or four hours it will have produced the desired effect; it may then be washed off with clean water; if not deep enough, it may be repeated.

There is still another mode of effecting this imitation. Take a piece of lunar caustic, about the size of a pea, grind it with water on a stone, and mix with it a sufficient portion of gum-arabic to make it of a proper consistence, then apply it with a brush to the horn in imitation of the veins of tortoise-shell. A little red lead, or some other powder, mixed with it to give it a body, is of advantage. It will then stain the horn quite through, without hurting its texture and quality. In this case, however, you must be careful, when the horn is sufficiently stained, to let it be soaked for some hours in plain water, previous to finishing and polishing it.

A Varnish to preserve Glass from the Rays of the Sun.

Reduce a quantity of gum-tragacanth to fine powder, and let it dissolve for twenty-four hours in white of eggs well beat up; then rub it gently on the glass with a brush.

To imitate Rosewood.

Take half a pound of logwood, boil it with three pints of water till it is of a very dark red, to which add about half an ounce of salt of tartar; and, when boiling hot, stain your wood with two or three coats, taking care

take it is nearly dry between each; then with a stiff flat brush, such as you use for graining, make streaks with a very deep black stain, which, if carefully executed, will be very near the appearance of dark rosewood.

The following is another method: Stain your wood all over with a black stain, and when dry, with a brush as above, dipped in the brightening liquid, form red veins in imitation of the grain of rosewood; which will produce, when well managed, a beautiful effect.

A handy brush for the purpose of veining may be made by taking a flat brush, such as you use for varnishing, and cutting the sharp points off the hairs, and making the edge irregular; by cutting out a few hairs here and there, you will have a tool which, without any trouble, will imitate the grain with great accuracy.

To Imitate Black Rosewood.

The work must be grounded black; after which take some red lead well ground, and mixed up as before directed, which lay on with a flat stiff brush, in imitation of the streaks in the wood; then take a small quantity of lake, ground fine, and mix it with brown spirit-varnish, carefully observing not to have more colour in it than will just tinge the varnish; but should it happen, on trial, to be still too red, you may easily assist it with a little umber, ground very fine, or a small quantity of Vandyke-brown, which is better; with which pass over the whole of the work intended to imitate black rosewood, and it will have the desired effect: indeed, if well

done, when it is varnished and polished, it will scarcely be known from rosewood.

A fine Black Varnish for Coaches and Iron work.

Take two ounces of bitumen of Palestine, two ounces of resin, and twelve ounces of umber; melt them separately, and afterwards mix them together over a moderate fire. Then pour upon them, while on the fire, six ounces of clear boiled linseed oil, and keep stirring the whole from time to time; take it off the fire, and, when pretty cool, pour in twelve ounces of the essence of turpentine.

A Varnish to Imitate the Chinese.

Put four ounces of powdered gum-lac, with a piece of camphor about the size of a hazlenut into a strong bottle, with a pound of good spirits of wine. Shake the bottle from time to time, and set it over some hot embers to mix for twenty-four hours, if it be in winter; in summer time, you may expose it to the sun. Pass the whole through a fine cloth, and throw away what remains upon it. Let it settle for twenty-four hours, and you will find a clear part in the upper part of the bottle, which you must separate gently, and put into another vial; and the remains will serve for the first layers or coatings.

To clean Silver Furniture.

Lay the furniture piece by piece upon a charcoal fire; and when they are just red, take them off and boil

them in tartar and water, and your silver will have the same beauty as when first made.

To colour the Backs of Chimneys with Lead Ore.

Clean them with a very strong brush, and carefully rub off the dust and rust; pound about a quarter of a pound of lead ore into a fine powder, and put it into a vessel with half a pint of vinegar; then apply it to the back of the chimney with a brush. When it is made black with this liquid, take a dry brush, dip it in the same powder without vinegar, then dry and rub it with this brush, till it becomes as shining as glass.

To clean Marble, Sienna, Jasper, Porphyry, &c.

Mix up a quantity of the strongest soap-lees with quicklime, to the consistence of milk, and lay it on the stone, &c., for twenty-four hours; clean it afterwards with soap and water, and it will appear as new.

This may be improved by rubbing or polishing it afterwards with fine putty powder and olive oil.

A white for inside Painting, which, in about four hours dries and leaves no smell.

Take one gallon of spirits of turpentine and two pounds of frankincense; let them simmer over a clear fire till dissolved, then strain and bottle it. Add one quart of this mixture to a gallon of bleached linseed oil, shake them well together, and bottle them likewise. Grind any quantity of white lead very fine with spirits

of turpentine, then add a sufficient quantity of the last mixture to it till you find it fit for laying on. If it grows thick in working, it must be thinned with spirit of turpentine: it gives a flat or dead white.

To take Ink Spots out of Mahogany.

Apply spirits of salt with a rag, until the spot disappears, and immediately wash with clear water. Or, to half a pint of soft water put an ounce of oxalic acid, and half an ounce of butter of antimony; shake it well, and when dissolved it will be very useful for extracting stains out of mahogany, as well as ink, if not of too long standing.

To make Paste for Furniture.

Scrape four ounces of beeswax into a pot or basin; then add as much spirits of turpentine as will moisten it through; at the same time, pound a quarter of an ounce of resin and add to it: when it is dissolved to the consistence of paste, add as much Indian red as will bring it to a deep mahogany colour: stir it up, and it is fit for use.

Another sort of paste may be made as follows:—

Scrape four ounces of beeswax as before; then take a pint of spirits of turpentine in a clean glazed pipkin, to which add an ounce of alkanet root; cover it close, and put it over a slow fire, attending it carefully, that it may not boil or catch fire; and when you perceive the colour to be drawn from the root, by the liquid being of a deep

red, add as much of it to the wax as will moisten it through; at the same time, add a quarter of an ounce of powdered resin, cover it close, and let it stand six hours, and it will be fit for use.

To make Oil for Furniture.

Take linseed oil; put it in a glazed pipkin, with as much alkanet root as it will cover; let it boil gently, and you will find it become of a strong red colour; let it cool, and it will be fit for use. Or, boil together cold drawn linseed oil and as much alkanet as it will cover, and to every quart of oil add two ounces of the best rose pink; when all the colour is extracted, strain it off, and for every quart add a gill of spirits of turpentine; it will be a very superior composition for soft and light mahogany.

To brown Gun Barrels.

Rub the barrel, after it is finished, with aqua-fortis, or spirit of salt diluted with water. Lay it by for a week, till a complete coat is formed. Then apply a little oil, and, after rubbing the surface dry, polish it with a hard brush and a little beeswax.

To clean Pictures.

Having taken the picture out of its frame, take a clean towel, and making it quite wet, lay it on the face of your picture, sprinkling it from time to time with clear soft water: let it remain wet for two or three days; take

the cloth off, and renew it with a fresh one; after wiping your picture with a clean wet sponge, repeat the process till you find all the dirt soaked out of your picture; then wash it well with a soft sponge, and let it get quite dry; rub it with some clear nut or linseed oil, and it will look as well as when freshly done.

Another Method.

Put into two quarts of strong lye a quarter of a pound of Castile soap rasped very fine, with about a pint of spirits of wine; let them simmer on the fire for half an hour, then strain them through a cloth; apply it with a brush to the picture, wipe it off with a sponge, and apply it a second time, which will effectually remove all dirt; then, with a little nut oil warmed, rub the picture, and let it dry; this will make it look as bright as when it came out of the artist's hands.

Varnish for Clock Faces, &c.

Take of spirits of wine one pint; divide it into four parts; mix one part with half an ounce of gum mastic, in a bottle by itself; one part of spirits and half an ounce of gum sandrac in another bottle; and one part of spirits and half an ounce of the whitest part of gum benjamin; mix and temper them to your mind; if too thick, add spirits; if too thin, some mastic; if too soft, some sandrac or benjamin. When you use it, warm the silvered plate before the fire, and with a flat camel-hair pencil stroke it over till no white streaks appear; which will preserve the silvering for many years.

Varnish for Balloons.

Take some linseed oil, rendered drying by boiling it with two ounces of sugar of lead and three ounces of litharge for every pint of oil till they are dissolved, which may be in half an hour. Then put a pound of birdlime and half a pint of the drying oil into an iron or copper vessel, whose capacity should equal about a gallon, and let it boil very gently over a slow charcoal fire, till the birdlime ceases to crackle, which will be in about half or three-quarters of an hour; then pour upon it two pints and a half more of the drying oil, and let it boil about an hour longer, stirring it frequently with an iron or wooden spatula. As the varnish, whilst boiling, and especially when nearly ready, swells very much, care should be taken to remove, in those cases, the pot from the fire, and to replace it when the varnish subsides; otherwise, it will boil over. Whilst the stuff is boiling, the operator should occasionally examine whether it has boiled enough, which may be known by observing whether, when rubbed between two knives, which are then to be separated from one another, the varnish forms threads between them, as it must then be removed from the fire. When nearly cool, add about an equal quantity of oil of turpentine. In using the varnish, the stuff must be stretched, and the varnish applied lukewarm. In twenty-four hours, it will dry.

As the elastic resin, known by the name of Indian rubber, has been much extolled for a varnish for bal-

loons, the following method of making it, as practised by M. Blanchard, may not prove unacceptable: Dissolve elastic resin cut small in five times its weight of rectified essential oil of turpentine, by keeping them some days together. Then boil one ounce of this solution in eight ounces of drying linseed oil for a few minutes; strain the solution, and use it warm.

Hugoulin's Method of Preparing Oil-paints.

Prepare in a glass or earthenware vessel a thin homogeneous paste of water and a quantity of one of the following substances reduced to fine powder.

	Parts by weight.	Parts by weight. Water.
For White oxide of zinc	1000	300 to 400
" Gray oxide of zinc	1000	150 to 180
" White lead	1000	150 to 180
" Red lead	1000	80 to 160
" Lampblack	1000	about 1000

To this paste add the quantity of linseed oil required for the preparation of a paint of proper consistence and stir with a spatula, spoon or knife for a few minutes, whereby the oil combines with the coloring matter. Decant off the supernatant perfectly clear water, and knead the remaining mass to remove all the water. Finally a viscid mass remains, which is diluted with sufficient oil to allow of its being worked with the brush. This paint, as proved by the separation of the water, is an actual combination and also has the appearance of such. If other mineral substances, for instance, ocher, mineral colors, copper compounds, etc., are treated in the manner above described, a separation of water would not take place, and no matter how long the stirring and kneading of the mass might be

continued, the result would always be a mixture of the three substances—pigment, water and oil. A combination is only formed with the use of linseed oil and white lead, white and gray oxide of zinc, chrome yellow or lampblack, which explains the preference given to these pigments, their efficacy as a protective coat for wood and metal having been practically proved.

The process for the preparation of such oil-paints on a larger as well as a smaller scale is as follows: The pigment—oxide of zinc, white lead, red lead, or chrome yellow—is reduced to a powder and worked with water to a dough by means of a spatula or similar tool. This dough is then reduced by the addition of more water to a thin paste or milk, which is passed through a silk sieve. The quantity of water used makes no difference; it may be so considerable, that the paste or milk is rendered quite fluid and passes rapidly through the sieve. Upon the latter remains only a very small quantity—about ½ per cent. of the pigment—which is used for the next operation, as well as all foreign admixtures, so that the paint is entirely freed from them, an advantage which is not attained by grinding in a mill or upon a grind-slab with the muller.

The paste or milk thus produced is allowed to settle, which may require several hours or even a few days. The supernatant water is then decanted off, the requisite amount of oil added, and the whole stirred for several minutes. The dough balls together to a crummy mass and is thoroughly kneaded to remove all the remaining water. Immediately before use, the paste is mixed with the necessary quantity of oil and siccative, and then forms an oil-paint of homogeneous grain and great fineness.

This new process has been tested in the preparation

of oil-paints on a quite extensive scale, and always yielded good results. As regards the grey oxide of zinc, the paste formed from it should be dried, pulverized and in a dry state passed through a sieve, since by continued contact with water it would be completely oxidized and form a solid mass, soluble with difficulty in oil. Lampblack is rather difficult to mix with water. For this purpose moisten it first with water containing 10 per cent. of alcohol, and mix with a trowel until the mixture has acquired the moisture of fresh snuff. In this state the lampblack can be readily divided in water. It is then allowed to settle, and after decanting off the supernatant water, is mixed with the requisite quantity of oil.

Balmain's Luminous Paint.

A luminous paint which contains no phosporus is chemically a combination of an alkaline earth with sulphur, oxygen and some water. However, its property of emitting light is dependent not only on its chemical composition and proper combination, but also on a special molecular condition. Hence a chemical analysis of the paint cannot by itself yield accurate results, and for this reason it has thus far been impossible to imitate Balmain's luminous paint, which is now manufactured by an English company.

Balmain's luminous paint is furnished in the form of an oil paint and of a water-color. It possesses the remarkable property of absorbing daylight or another strong light, and re-emitting it in the dark. Moreover, it is so extraordinarily sensitive to light that an inductive spark suffices to render it luminous in the dark. The power of emitting light depends, of course, on the strength of the light conveyed to the paint and

the duration of its action, as well as on the quantity of paint applied. The thicker the coat of paint and the longer and the more intensely the light has acted upon it, the stronger and more durable will be the light emitted by the painted article. When suddenly brought from the light into darkness, the article emits a violet light, passing later on into white, and gradually yields weaker and weaker waves of light until it can finally be perceived only by the perfectly rested eye. On being returned to the light, the luminous paint immediately re-absorbs light, and to render an article coated with the paint luminous during the longest winter night, an exposure of it to the light during the day is sufficient. The absorption and emission of light are, of course, prevented by the gradual accumulation of dirt upon the surface. Heat exerts a peculiar action upon the luminous surface, it effecting a stronger emission of light, *i. e.*, the light which otherwise is yielded slowly, is emitted more or less rapidly according to the degree of heating, and, of course, does not last so long.

The luminosity is destroyed by hydrochloric and nitric acids, as well as by varnishes or paints containing lead. Hence for thinning and coating the luminous paint a special varnish is employed, as well as a suitable black paint for letters to be painted on it.

Articles already provided with a coat of ordinary oil paint have to be painted, before applying the luminous paint, with a neutral ground paint. To prevent rusting, iron has also to be provided with a coat of neutral ground paint. The latter may be recommended on account of its cheapness, and also as a first coat for porous or rough stones, etc., the uneveness being thereby somewhat remedied, and the

effect of the luminous paint considerably increased. Three coats of luminous paint are sufficient for any article, and are as durable as the best oil paint, especially when provided with a coat of prepared varnish. One pound of luminous oil paint suffices for giving three coats to a surface of 12 square feet.

The luminous water-color has in general the same properties as the luminous oil-paint, only like all other water-colors, it should not be used for out-door purposes. It is furnished in the form of a dry powder which is dissolved, with constant stirring, in luke-warm water (about $1\frac{1}{2}$ quarts of water for 10 lbs. of paint), the mixture thus obtained sufficing for giving three coats to a surface of 70 square feet. Articles of new unpainted wood, plaster of paris, paste-board, etc., are painted, before laying on the luminous paint, with a solution of a prepared chemically pure gelatine (1 part of gelatine to 12 of water). The luminous paints should only be laid on with new, perfectly clean brushes, and should be thoroughly shaken and stirred before and during the work. One coat must be thoroughly dry before applying the next.

Although a coat of luminous paint laid on in accordance with the directions given above yields perfectly satisfactory results, it must be remembered that the luminosity is apparent only in perfect darkness, and hence such a coat of paint would be entirely useless in half-dark places or in localities accessible to artificial light. Thus it would be of no use to apply the paint to street signs in lighted cities, while on the other hand a guide-post on a public road, the arms of which are painted with luminous paint and provided with directions, would in every way answer the intended purpose.

Many experiments made in unsuitable places have led to wrong ideas in regard to luminous paints. It must be remembered that the paint itself is not luminous, but simply possesses the property of absorbing light and emitting it in the dark.

When entering a dark room in which highly inflammable articles are stored, it is advisable, in order to avoid all danger, to use as a lantern large plates painted with luminous paint.

As the luminous paint is effective also under water, divers, whose dresses and tools have been painted with it, can work at considerable depth by the light emitted from it, and, according to the statements of Mr. P. Hedger, manager of the Southampton Dock Co., divers equipped in this manner, who were working around a wreck lying in 26 feet of water, could distinctly see the rivets and bolts of the vessel.

It is not necessary to further enumerate the many public and private purposes for which luminous paint may be used. It is also prepared in the form of a wax-mass and in this state is used by jewelers, manufacturers of glass ornaments, etc., and for the preparation of artificial fish-bait.

The preparation of luminous paint is as follows: Oyster-shells cleaned with warm water are placed in the fire for half an hour, then taken out and allowed to cool. They are next reduced to a fine powder and the worthless gray portions removed. The powder is packed with alternate layers of sulphur in a crucible. The lid is then placed upon the latter and luted with a cement made by stirring sand with beer to a thick paste. The crucible is heated to a red heat for one hour, when its contents will be white. The powder is carefully sifted and mixed with gum water to the consistency of a paint.

An invention patented by Gustav Schatte, of Dresden, has for its object to produce durable white or colored paints containing a luminous substance, which causes them to shine in the dark, without changing or neutralizing in daylight the tint of the coloring substance or substances contained in such paints.

For this purpose Zanzibar or Kauri copal is melted over a wood fire; 15 parts of the melt are dissolved in 60 parts of French oil of turpentine, the solution is filtered and mixed with 25 parts of pure linseed oil previously heated and then slightly cooled off. The varnish thus obtained is carefully worked into luminous paint in a grinding mill, according to one of the processes to be given later on. Iron rolls should be avoided, as particles of iron, which are liable to be detached, would destroy the luminosity of the paint.

Commercial varnish nearly always contains manganese or lead, and cannot be used, as it would destroy the luminosity of the paint.

Pure white luminous paint is prepared as follows: Mix 40 parts of the varnish above described with 6 parts of prepared barium sulphate, 6 parts of prepared carbonate of lime, 12 parts of prepared white zinc sulphide, and 36 parts of luminous calcium sulphide, in a suitable vessel to an emulsion, and grind the mixture fine in a color mill.

Red luminous paint. Mix 50 parts of the varnish above described with 8 parts of prepared barium sulphate, 2 parts of prepared madder lake, 6 parts of prepared red orpiment, and 34 parts of luminous calcium sulphide. Preparation the same as for white paint.

Orange luminous paint. Mix 46 parts of the varnish above described with 17½ parts of prepared barium sulphate, 1 part of Indian yellow, 1½ parts of prepared

madder-lake, and 34 parts of luminous calcium sulphide. Preparation as above.

Yellow luminous paint. Mix 48 parts of the varnish above described with 10 parts of prepared barium sulphate, 8 parts of barium chromate, and 34 parts of luminous calcium sulphide. Preparation as above.

Green luminous paint. Mix 48 parts of the varnish above described with 10 parts of prepared barium sulphate, 8 parts of chrome green and 34 parts of luminous calcium sulphide. Preparation as above.

Blue luminous paint. Mix 42 parts of the varnish above described with 10.2 parts of prepared barium sulphate, 6.4 parts of ultramarine, 5.4 parts of cobalt blue, and 36 parts of luminous calcium sulphide. Preparation as above.

Violet luminous paint. Mix 42 parts of the varnish above described with 10.2 parts of prepared barium sulphate, 2.8 parts of ultramarine violet, 9 parts of cobaltous arsenate, and 36 parts of luminous calcium sulphide. Preparation as above.

Gray luminous paint. Mix 45 parts of the varnish above described with 6 parts of prepared barium sulphate, 9 parts of prepared calcium carbonate, ½ part of ultramarine, ½ part of gray zinc sulphide and 36 parts of luminous calcium sulphide. Preparation as above.

Yellowish brown luminous paint. Mix 48 parts of the varnish above described with 10 parts of prepared barium sulphate, 8 parts of yellow orpiment, and 34 parts of luminous calcium sulphide. Preparation as above.

Luminous paints for art purposes are prepared by substituting in the mixtures above given the same quantity of pure poppy seed oil for the varnish, and grinding the product with special care.

All the luminous paints given above may be used for colored papers and other purposes by omitting the varnish and grinding the color mixtures with water and an agglutinate free from acid. Luminous paints for painting on hollow glass ware and similar articles may be prepared by adding instead of the varnish 10 per cent. of Japanese wax and one-fourth part of the latter of olive oil.

Paint for Vessels, Submarine Works, etc.

Concentrated solution of potash 160 parts by weight, grape sugar 80; add a solution of 320 parts by weight of sulphate of copper. When this solution is heated, a precipitate of hydrated oxide of copper is formed; this is filtered and carefully dried and mixed with 6¼ parts by weight of 75 per cent. carbolic acid. Heat the mass, and add sufficient crude linseed oil to make it the consistency of thick paint. For use reduce with linseed oil. This paint is claimed to be poisonous to animal and vegetable bodies depositing themselves on vessels which have been painted with it.

Imitation Mahogany.

French artisans adopt the following treatment for representing mahogany: The surface having been planed and rendered perfectly smooth, the wood is rubbed with dilute nitric acid. Afterwards a filtered mixture of 1½ ozs. of dragon's blood dissolved in 1 pint of spirits of wine is added to one-third that quantity of carbonate of soda. This thin liquid is brushed with a soft brush over the wood, the operation being repeated at short intervals until the wood assumes the external appearance of mahogany with a mirror-like polish on the surface. Should this brilliancy decline, it may be

restored by rubbing with a little cold drawn linseed oil.

Black Enamel for Wood.

The following receipt may be of value to painters: Prime the wood with linseed oil, oil of turpentine and white lead; then give it two or three coats of black, mixed with copal varnish and turpentine. Rub it down with pumice stone and water, and finally varnish with copal. Again rub down and polish with oil and rotten stone to obtain perfect smoothness.

Driers.

Driers are a class of bodies added to oil for the purpose of causing it to dry more quickly than it would otherwise do. The bodies generally used for this purpose are salts of iron, lead, manganese, and zinc.

The following list comprises all the compounds used as driers in paints and varnishes: Red lead, litharge, lead acetate, lead borate, manganese oxide, manganese sulphate, manganese borate, manganese oxalate, zinc oxide, zinc sulphate, and ferrous sulphate.

Besides the simple driers mentioned above, a variety of compound driers, usually composed of mixtures of single driers in various proportions, or with some linseed oil or boiled oil, are made. A few receipts for the production of those principally in use will be given.

Patent driers. Mix 15 parts by weight of dried zinc sulphate, 4 of lead acetate and 7 of litharge, with 4 of boiled oil, and grind well together.

On the other hand, mix 100 parts by weight of Paris white and 50 of white lead with 30 of boiled oil, grind and then mix with the first mixture, adding sufficient boiled oil to give the mass the consistency of soft dough.

Zumatic drier. Zinc carbonate 90 parts by weight, manganese borate 10, linseed oil 90. Grind thoroughly and keep in tin tubes. The proportions generally used are 1 lb. of the drier to 25 lbs. of paint. It is a powerful drier in a convenient form.

Guynemer's drier. Maganese sulphate 1 part, manganese acetate 1 part, calcined zinç sulphate 1 part, white zinc oxide 97 parts. Grind the sulphates and acetates to an impalpable powder, and sift through a metallic sieve. Dust 3 parts of this powder over 97 parts of zinc oxide spread out over a slab or board, mix thoroughly and grind. The resulting powder, mixed in the proportion of ½ to 1 per cent. with zinc white, will enormously increase the drying property of this body, which will become dry in a few hours.

Painter's driers. Litharge ground to a paste with drying oil. For dark colors.

Sugar of lead and drying oil. For pale colors.

Oxidized oil drier. Oxidixed oil or well boiled linseed oil makes a good drier, very useful in many cases.

To Prepare Zinc for Painting.

Dissolve in 64 parts of water, 1 part each of chloride of copper, nitrate of copper and sal ammoniac; and then add 1 part of commercial hydrochloric acid. Brush the zinc over with this mixture, which gives a deep black. Leave it to dry for 24 hours, when any oil color will firmly adhere to it, and withstand both heat and damp.

Wood-Fillers.

1. Starch 12 parts, heavy spar 12, siccative 2, oil of turpentine a sufficient quantity.

Make of the consistency of ordinary varnish, and for

dark woods add up to 1 part by weight of umber. Apply the filler with a medium stiff brush. When the coat, at first lustrous, becomes dull, remove everything from the surface by rubbing across the grain of the wood with a piece of felt or strong leather fastened to a piece of wood. Allow the prepared wood to dry 8 hours, then rub thoroughly with glass paper, when it is ready for polishing.

2. *Hard wood filler.* Use boiled oil and enough corn starch to make a very thick paste. Add a little japan and reduce with turpentine. Add no color for white oak; for dark ash and chestnut use a little raw sienna; for walnut, burnt umber and a very little Venetian red; for bay wood, burnt sienna. Use enough color to cover the white of the starch. Apply with brush and rags. Let dry 48 hours, then sandpaper. For second coat use less oil, but more japan and turpentine.

3. *German wood filling.* Fill the pores of the wood with fresh tallow and plaster of Paris well amalgamated before a fire, if the weather is cold. Darken, if required, with any coloring to suit. When well rubbed in give a coat of shellac, and French polish or varnish.

4. Boiled linseed oil 1 quart, spirits of turpentine 3 quarts, corn starch 5 lbs., japan 1 quart, calcined magnesia 2 ozs. Mix thoroughly.

5. Linseed oil 1 quart, spirits of turpentine ½ pint; lime, the size of a base ball, broken fine. Let the mixture simmer on a stove in a covered vessel for two or three hours; then strain through a coarse cloth. Apply to the wood and after 24 hours rub off with a woolen cloth, and polish.

6. *Filling for cracks.* A very complete filling for open cracks in floors, etc., may be made by thoroughly

soaking newspaper in paste made of 1 lb. flour, 3 quarts water and a tablepoonful of alum, thoroughly boiled and mixed. Make the fluid mixture about as thick as putty, and it will harden like papier mache. This preparation may be used for moulds for various purposes.

Knotting.

The purpose of "knotting" is to guard against the knots appearing in the finished work by stopping their absorbent quality, or closing the apertures of the fibre, and thus preventing the effusion of gum or sap.

A preparation, known as "Knotting," which is used for that purpose, may be purchased at the paint-shops, but the following are two excellent receipts for making similar compositions, which are to be applied with a small brush :

I. Mix ¼ pint of japanner's gold size, 1 teaspoonful of red lead, 1 pint of wood naphtha, and 7 ozs. of orange shellac. Keep the mixture in a warm place until the shellac is entirely dissolved, shaking it frequently.

II. White or red lead mixed with glue size, and applied warm.

Mixing Kalsomine.

Whiting 10 lbs., sal soda ½ lb., white glue ¾ lb., linseed oil 1 quart. Dissolve the sal soda in hot water, then stir in the oil, add more warm water and stir in the whiting. Melt the glue in the usual manner and stir that in, and the kalsomine is finished.

A lime kalsomine or wash very good for cheap work is made as follows : Take six quarts thick lime whitewash, made of the best lime slaked in hot water. Mix oil of turpentine and linseed oil, each ½ pint, and

stir it in while the wash is hot, then add $\frac{1}{2}$ lb. of powdered alum. Have the mixture thick enough to cover like kalsomine, and put it on with a kalsomine brush. The edges dry slow, and no matter how much suction there may be in the wall, the wash will spread smooth and easy.

Cleaning and Restoring Works in Oil-Painting.

Of the importance of this minor function of the art of painting, a just estimate may be formed, by considering that there is hardly a limit to the time which works in oil-painting may be preserved by care and attention. These are subject to deterioration and disfigurement simply by dirt—by the failure of their grounds,—by the obscuration and discolorment of vehicles and varnishes,—by the fading and changing of colors,—by the cracking of the body and surface,—by damp, mildew, and foul air,—and by mechanical violence. The first thing necessary to be done is to restore the ground, if on canvas, by stretching or lining with new canvas. In cases of simple dirt, washing with a sponge or soft leather with soap and water, judiciously used, is sufficient. Varnishes are removed by friction or solution, or by chemical and mechanical means united, when the varnish is combined, as commonly happens, with oil and a variety of foulness.

Removing Varnish from Pictures or Fine Work.

In removing varnish by friction, if it be a soft varnish, such as that of mastic, the simple rubbing of the finger-ends, with or without water, may be found sufficient; a portion of the resin attaches itself to the fingers, and by continued rubbing removes the varnish. If it be a hard varnish, such as that of copal,

which is to be removed, friction with sea or river sand, the particles of which have a rotundity that prevents their scratching, will accomplish the purpose.

The solvents commonly employed for this purpose are the several alkalies, alcohol, and essential oils, used simply or combined. Of the alkalies, the volatile in its mildest state, or carbonate of ammonia, is the only one which can be safely used in removing dirt, oil, and varnish, from a picture, which it does powerfully; it must therefore be much diluted with water according to the power required, and employed with judgment and caution, stopping its action on the painting at the proper time by the use of pure water and a sponge.

Many other methods of cleaning have been recommended and employed, and in particular instances, for sufficient chemical reasons, with success; some of which we will recount, because, in art so uncertain, it is good to be rich in resources.

A thick coat of *wet fuller's earth* may be employed with safety, and, after remaining on the paint a sufficient time to soften the extraneous surface, may be removed by washing, and leave the picture pure—and an architect of the author's acquaintance has succeeded in a similar way in restoring both paintings and gilding to their original beauty by coating them with wet clay. Ox-gall is even more efficacious than soap.

In filling cracks and replacing portions of the ground, putty formed of white-lead, whiting, varnish, and drying oil, tinted somewhat lighter than the local colors require, may be employed, as plaster of Paris may also in some cases; and, in restoring colors accidentally removed, it should be done with a vehicle of simple varnish, because of the change of tint which takes place after drying in oil.

Removing Paint from woodwork, etc.

Burning off, etc. In those cases in which it is requisite to remove painting entirely from its ground, it is usual to resort to mechanical scraping, etc., or to the very dangerous operation of setting fire to the painted surface immediately after washing it over with oil of turpentine, called *turps*, for burning off the paint from old disfigured work; an operation that may be safely and more easily accomplished by laying on a thick wash or plaster of fresh slacked quicklime mixed with soda: which may be washed off with water the following day, carrying with it the paint, grease, and other foulness, so that when clear and dry, the painting may be renewed as on fresh work. Clear colling is sometimes resorted to over old painting, for the purpose of repainting, in which case the surface exposed to the sun's rays or alterations of temperature is liable to become blistered and scale off.

DISEASES AND ACCIDENTS

TO WHICH PAINTERS AND VARNISHERS ARE PARTICULARLY LIABLE.

THE business of a painter and varnisher is generally and not without reason, considered an unhealthy one. Many of the substances which he is necessarily in the habit of employing are of a nature to do injury to the constitution; and great caution and care are required to prevent these from producing serious consequences. Much, however, of the mischief that is done arises from the want of proper precaution; the being ignorant of the symptoms of disorder, or want of due attention to them in the beginning; and, more than all, the use of improper remedies, from being unacquainted with those that ought to be used. I think, therefore, that I shall be rendering an acceptable service to the painter and varnisher by mentioning the principal diseases to which their occupations render them more liable than persons differently employed, with the proper means of remedy.

Painter's Colic.

This disease, the most common and the most dangerous to which painters are liable, arises with them from breathing in the fumes and handling the different pre-

parations of white lead. It is a violent species of colic, and may be produced by other causes; but when it proceeds from lead, it is always the most obstinate, and the most tedious and difficult of cure.

The first symptoms are a pain at the pit of the stomach, gradually increasing and proceeding downwards to the bowels; it is particularly violent round the navel. The person is likewise afflicted with frequent belching, slight sickness at the stomach, continued thirst, a quick short pulse, a confinement of the bowels, and repeated attempts to obtain a stool without effect.

When some or all of these symptoms are experienced, a strong dose of castor oil should be immediately taken and repeated till it opens the body freely. If it will not act, calomel pills must be taken in turn with the castor oil; and should both these fail to purge effectually, a clyster must also be employed, composed of ten ounces of senna and three grains of opium in solution. The warm bath, as well as warm fomentations in flannel cloths of the lower part of the stomach, are extremely serviceable in relieving the spasms; and should the symptoms continue, a blister applied to the abdomen may prove useful.

The person affected should be kept as quiet as possible, both in body and mind: he should take no wine, spirits, malt liquor, nor any kind of solid food; but should confine himself to broth diet, and copious draughts of weak diluting drinks, such as barley-water.

Where the bowels are very obstinately confined, and the person is young and of a full habit, it may be advis-

able to begin with taking from him a quantity of blood, according to circumstances, in order to prevent inflammation.

I have not mentioned the strength of the doses to be employed as purgatives, because that must be determined by the constitution of the sick person and the manner in which the medicines operate. In a general way, remember never to give too strong a dose at once, as it can always be repeated as often as may be found necessary.

If the remedies I have mentioned prove successful in removing the early symptoms of the dry belly-ache, which will generally be the case, the person who has suffered, on returning to his work, should, if possible, entirely avoid, for some time, all parts of his business in which preparations of lead are employed. He should, also, long after he may seem to feel quite well, keep to the light diet I have mentioned above, or he may bring on a relapse worse than the first attack of the disorder.

Few distempers grow more rapidly worse, and it is of the utmost importance to attend to its first symptoms, for if these are neglected, the most frightful consequences ensue. The violence of the pains increases beyond description; the outside of the belly feels pain at the slightest touch, and the muscles inside become wrapped into knots; a difficulty of making water, sometimes amounting to almost a total stoppage, takes place; and the bowels are so contracted by spasms as scarcely to admit a clyster. If these symptoms proceed, the spasms become more frequent and violent; and either the costiveness cannot be overcome, (in which case inflammation in the

bowels succeeds, and the patient's death is certain,) or, if his life be saved, he generally remains a victim, in a greater or less degree, to the palsy.

I have mentioned these fatal circumstances to show the necessity of immediately attending to the first appearance of this dangerous disorder. In an advanced state of it, I do not pretend to prescribe—the best medical assistance must immediately be obtained. The remedies I have recommended are only designed for that early stage of the distemper of which the symptoms have already been described. They may then be used with advantage, and, if persevered in, will prevent the danger of severer suffering.

Weakness of the Wrists.

This is a partial kind of palsy, which sometimes remains after the painter's colic is cured. In some cases, too, it comes on without any previous attack of that disorder, where the injury has been more owing to handling lead than inhaling its fumes.

Where this weakness of the wrists is experienced by a painter, let him take, three or four times a-day, a dose of nitrate of silver, of from one to three grains, according to the manner in which it may operate. Before taking each of these doses, he should also take some castor oil. If it purge him too violently, let a little opium be mixed with the dose, lest bloody stools should be brought on. It is better to give the nitrate of silver in solution than in a solid form.

Where the bowels are so weak as to make any strong purge dangerous, this weakness of the wrists has often been cured by rubbing a drachm of strong mercurial ointment upon them every night and morning till the mouth became sore. Indeed, this will always be found a useful application.

One of the best methods in the weakness of the wrists arising from the handling of lead is, in addition to the taking of medicine or the application of mercurial ointment, to make use of a splint, made something like a battledore, fastened under the forearm, and continued to the extremities of the fingers. This has, in many instances, restored the strength of the wrists, even where the weakness amounted to complete palsy.

I have already observed that confirmed palsy may be the effect of a violent attack of the painter's colic. The remarks, however, which I made under that head apply here. I shall not venture to prescribe for that melancholy state of disease. My object is not to point out remedies for those extreme cases, but to suggest the best means of preventing them.

Effects of Poisonous Substances used in Painting and Varnishing.

These are principally lead, quicksilver, arsenic, and verdigris. Of the injurious effects of lead I have already spoken. Arsenic is found in some particular colours, especially in *orpiment* and *realgar;* and the circumstance is a strong objection to the use of them. Quicksilver

enters into the composition of various amalgams employed in lacquering and gilding. The poisonous properties of verdigris are well known.

It cannot be too strongly impressed upon the mind of the painter or varnisher that mineral poisons of every description are as effectually taken into the system of the body by handling them, or inhaling their fumes, as by actually swallowing them; and that the consequences, though not so immediately fatal, are as certainly injurious. Care should therefore be taken not to handle them more than is absolutely necessary; and likewise, by keeping a thorough draft of air, and leaning as little as possible over such substances during their preparation, to avoid, as much as in your power, the breathing in the fumes arising from them.

But as you cannot entirely escape these, it will be well to know how to distinguish their respective characters. The effects of lead are sufficiently distinguished by the peculiar diseases it produces, which have been noticed before. Arsenic and quicksilver are attended with different consequences. When the former has found its way into the stomach, it will occasion a pricking and burning sensation, with thirst and sometimes vomiting. A pain will likewise be felt in the bowels, but without producing purging. If, after using colours which contain a mixture of arsenic, you experience any of these symptoms, a little fresh charcoal, powdered fine, in small doses repeated, will be found very serviceable. An emetic should also be taken, and the body kept well open.

The fumes or handling of quicksilver produce, besides the symptoms mentioned in speaking of arsenic, salivation in a greater or less degree, bad breath, griping pains in the stomach, and severe purging. White of egg, dissolved in water and filtered, and diluted as circumstances require, is one of the best remedies when these symptoms are violent. A very good emetic, in such cases, is one ounce of sub-carbonate of magnesia dissolved in a pint of water; a glassful of the mixture being taken every few minutes, at such intervals as are needful to promote vomiting.

Verdigris is readily distinguished by its nauseous and corroding effects upon the stomach. If you have reason to think you have suffered from the frequent use of this colour, common sugar, taken in such quantities as to open the bowels frequently, will be found the very best remedy.

I strongly recommend to every painter and varnisher, when engaged in any part of his business which requires him to employ a poisonous substance, whether lead or any other, the use of tobacco—I mean *chewing* it. It is the most powerful check to a substance acting to produce spasms, by suspending the muscular action in the stomach. In short, tobacco possesses in this respect the advantages without the danger of opium, and has been found of the greatest service to persons in the trades above mentioned. At the same time, persons who use it for the purpose I have stated, should be careful not to indulge in the practice too freely; for the excessive chewing of tobacco will not only occasion a feeling of

stupid languor, which unfits a man for exertion, but may in time bring on a disease almost as much to be dreaded as the evils which it is intended to guard against.

Nausea.

Oil of turpentine, burnt oils of several descriptions, and some other substances used in painting and varnishing, give out fumes, which, though not of a poisonous nature, are apt to occasion a slight sickness at the stomach, accompanied with a headache and a fainting sensation, to persons whose nerves are not strong: and these effects are frequently felt by young people before they become accustomed to the business. In many cases, removing for a short time from the offensive fumes into a pure air, and drinking a very little spring water, will dissipate these feelings. If they return, some opening medicine, or an emetic should be taken, which, if a foul stomach, as often happens, has been the cause, will remove it. But if you are a beginner in the business, and find yourself constantly affected in this manner on such occasions, I would advise you to turn to some other occupation; for a person of decidedly weak nerves will be subject to constant ill health as a painter.

Burns and Scalds.

In no business are these accidents more liable to occur to the persons engaged in it than in painting, varnishing, and gilding.

In all scalds and burns, it is of the first importance to

apply a remedy at the instant. Spirit of wine or turpentine, applied at the moment, generally prevents the rising of blisters; if it be rectified spirits, it is so much the better. Spirit of wine or turpentine is decidedly the best immediate remedy when the skin is broken. If the violence or size of the burns or scalds render the application of the spirit in the common way too painful, cover the injured parts with pieces of bladder softened by dipping them in warm water, and keep the outer surface constantly wetted with the spirit.

When the burn is considerable, fresh yolk of egg (if spirit is not at hand) applied to it will relieve the pain and forward the cure. A salve composed of one part of yellow wax and three parts of olive oil, which you can easily make yourself and carry about you, in case of an accident, will likewise be extremely useful if applied at the moment of its happening.

Scraped potato is very often applied to a scald or burn. Some have pronounced it a certain cure, others have called it injurious: both parties are wrong. The fact is, it does nothing towards curing the burn; *but if applied at the first moment,* it prevents its becoming worse, and relieves the pain. It is therefore very right to apply it, if no other remedy be near, till a better can be procured. Water, however, is almost always to be obtained, and, in the absence of other remedies, should instantly be had recourse to. The part or parts which have been injured should, without a moment's delay, be plunged into very cold water, or plentifully pumped upon, and an astonishingly rapid change from torture to

ease will take place. After the immersion has continued a proper length of time, the parts injured should be covered with linen rags continually kept wetted with water, and streams of air passed over them from time to time by a pair of bellows, till the person feels a freezing sensation.

Water is always servicable in burns; and where the skin is not broken, many eminent surgeons consider it as the best of remedies.

GENERAL OBSERVATIONS.

I shall conclude this subject with a few general remarks, principally respecting the diet and manner of living of the painter; on which, indeed, his exemption from the diseases which so severely affect many in his trade mainly depend.

He should avoid all acid drinks, such as cider and effervescing liquors; and abstain as much as possible from sours both in food and drink, even the use of vinegar; for acids have a peculiar tendency to combine with any portion of lead that he may have imbibed, and will act upon the stomach in a most injurious manner.

When a griping feeling is experienced by the painter, he often has recourse to a glass of raw whisky, with the idea of obtaining relief. Now, he cannot commit a greater error. This feeling indicates the commencement of that dangerous disorder, the dry belly-ache, and spirituous liquors will both bring it on more rapidly and aggravate the symptons. There is, besides, a vulgar but most mistaken notion that spirits taken inwardly are useful in guarding against the fumes of lead and other poisonous substances. And it is melancholy to see the number of persons engaged in

the painting and varnishing trade who, from this false idea, are led to adopt the pernicious practice of drinking drams in the morning; and not infrequently, from the hold this destructive habit gains upon them, at other times of the day too. Now, so far from this practice being serviceable, I can assure the dram-drinking painter that, whenever he is attacked by that disease, so dangerous to those in his trade, he will find it rendered far more violent by his previous use of spirituous liquors, and more likely to terminate in inflammation or palsy. Ardent spirits in a raw state should never be touched by the painter ; and when taken mixed, they should rather be weak than otherwise.

I have had frequent occasion to observe that painters in general are partial to a great deal of solid and high-seasoned food. Now, it will be perceived that the disorder from which they have most to fear, and which is most common among them, is always attended by a confined state of the bowels, from which its principal danger arises. A painter who regards his health should always prefer such food as is light and easy of digestion ; and if he take any solids, it should be in small quantities, and not frequently. For the same reason, though I do not condemn malt liquor to a painter in good health, I should advise him not to take it in large quantities at a time, as it is heavy on the stomach. The lead which he cannot avoid more or less imbibing has a tendency to make him costive ; and his business is not, like some others, accompanied with strong exercise to promote digestion.

I need scarcely remark on the advantages of cleanliness in his person to him, since the handling of preparations of lead is one of the injurious parts of his occupation.

In conclusion, let me once more impress upon him the importance and necessity of TEMPERANCE. The neglect of it in a workman of any other description *may* bring him to *sickness*, *must* bring him to *poverty;* but the intemperate and drunken Painter or Varnisher makes the most rapid strides in his power to bring upon himself painful sickness, and very often premature death.

CHEVREUL'S PRINCIPLES OF HARMONY AND CONTRAST OF COLORS.

BY CHARLES MARTEL.*

In entering upon the study of the principles of Harmony and Contrast of Colors as established by M. Chevreul, it will be necessary for the reader to forget much that he may have learned from other sources.

The notions hitherto prevalent on this subject were very vague and empirical, not to say fanciful. They had no foundation in observation or experiment, consequently no formula or law could be deduced from them wherewith to guide the inquirer. M. Chevreul's work is based on strict scientific investigation; his observations and experiments can be repeated by every one, and their validity tested and verified. He has established the existence of a law which governs the phenomena of contrast of Colors, and his book develops the process by which he arrived at it, and the numerous applications to the arts of which it is susceptible.

There is an arrangement and a sequence in which these facts and principles must of necessity be placed. But it may be convenient to anticipate some of them; to bring them nearer together, by which their mutual connexion and reciprocal influence may be made more apparent. Among the principles which govern the harmony and contrast of colors, few can be taken absolutely or independently of others. By adopting one

* From The Principles of Harmony and Contrast of Colors and their application to the Arts, By M. E. Chevreul. Translated from the French by Charles Martel, London, 1890.

principle hastily before we have ascertained what other principles modify it, we fall into the errors attendant upon hasty generalization and false conclusions.

DEFINITIONS.

Primary Colors	Blue, Red, and Yellow.
Secondary Colors	Orange, Green, and Violet.
Normal Colors	The Colors of the Spectrum.
Binary Colors	Compounds of two Primaries.
Broken Colors	Colors in which all three primaries exist.
Complementary Colors	The primary or the secondary requisite to make up the complement of colored rays that constitute white light. The complementary of a primary, as red, is the secondary composed of the other two primaries (green).
Luminous Colors	Yellow, Orange, Red, Light Green, and the light tones of sombre colors.
Sombre Colors	Blue, Violet, and the broken tones of the luminous colors.
Warm Colors	The same as luminous colors.
Cold Colors	The same as sombre colors.
Pigments	Material Colors, or paints.
Gray (normal)	Normal Gray consists of pure black and white mixed in various proportions, producing a variety of tones from white to black.
Colored Grays	Normal Gray, to which a primary or a secondary is added.
Tertiary Colors	Colored Grays. Russet is red gray. Olive is blue gray. Citrine is yellow-gray.
Tones	The series of gradations of a pure color from its greatest intensity, weakened by the addition of white, or deepened by the addition of black.

Hue	The change produced in one pure Color by the addition to it of another pure color. The original color must always be in the ascendancy, otherwise it becomes a hue of the color added to it.
Scale.	The series of hues and tones of any given color.
Tints	The tones of a color produced by the addition of white added to the normal color.
Shades	The tones of a color produced by the addition of black to the normal color.
Prismatic Spectrum .	The image of a ray of light when decomposed by a prism. It consists of Blue, Red, and Yellow, and the combinations produced by their mixture or blending with each other, (secondaries) Orange, Green, Violet and its hues, purple, indigo, lavender, etc.

ANALYSIS OF LIGHT AND COLOR.

THE SOURCE OF COLOR.

As Light is the source of Color, it is necessary to commence with an examination of its composition, as the laws of contrast of colors are entirely dependent upon it.

When a ray of sunshine, or white light, as it is termed, passes through a glass prism, it is decomposed, or separated, and if the image formed, called the *prismatic spectrum*, is received upon a white screen, placed at a suitable distance from the prism, it will be found to consist of various colors, arranged in a certain order, like those of the rainbow.

These colors are six in number: three of which are simple; and three which are compound, resulting from the mixture of the simple colors in pairs.

Blue, Red, and Yellow are simple, or primary colors.

Green, Violet, and Orange are compound, or secondary colors.

The mixture of Blue with Red produces Violet.

The mixture of Blue with Yellow produces Green.

The mixture of Red with Yellow produces Orange.

These compound colors vary in hue according to the proportions of the simple colors of which they are formed: thus, by increasing the quantity of blue in the mixture of blue and red, we produce purple, indigo, etc. The same effect takes place with Greens.

The primary colors are simple and pure, they cannot, like the secondaries, be produced by the mixture of other colors.

It is evident that the color of the primaries cannot vary as color (or in *hue*), but only in intensity, at least so long as they are kept pure, but the hues of the secondaries may vary infinitely, according as one or the other predominates.

THE TYPE, OR STANDARD, OF COLOR.

To avoid misapprehension when speaking of colors, it is necessary to refer to some invariable type or standard of color, so that when speaking of Blue, we may not be in doubt as to whether the color represented by Prussian Blue, or by Cobalt Blue is meant. This type, or standard, is supplied by nature in the prismatic spectrum, and—although in a weaker degree—in the rainbow. Therefore, whenever we speak of pure colors, those representing the colors of the spectrum must be understood. They are called also normal colors.

ON THE MIXTURE OF COLORS.

We must never lose sight of the fact, that the results predicated of the mixture of colors, taken theoretically, are not obtained by mixing pigments, or paints, and dyes.

Theoretically, the mixture, or combination of the colors of the prismatic spectrum, by means of a lens or concave mirror, produces a ray of white light; but when we mix pigments representing those colors, taken as pure as we can possibly obtain them, the mixture is not

white, but gray or black, according to their intensity etc.:

For every Blue pigment contains also either red or yellow;

Every Red pigment contains also either blue or yellow;

Every Yellow pigment contains also either blue or red.

And although, as we have said, the union of the blue, red, and yellow of the spectrum produces *white*, the union of blue, red, and yellow pigments produces gray or *black*.

If we had pigments that were in color as pure as those of the spectrum, their mixture would also yield pure colors.

Ultramarine is the only pigment that approaches a prismatic color in its purity, but even that has a slight tinge of red in its composition, causing it to appear violet.

We can take gamboge as the representative of pure Yellow, carmine as that of Red, and Prussian blue as that of Blue.

In mixing pigments to obtain pure secondary colors, we shall obtain a better result if we select such as are free from the color not essential to the compound. Thus, to obtain a pure green, which consists of blue and yellow only, we must take a blue tinged with yellow rather than with red, and a yellow tinged with blue rather than with red; if we took either of those pigments tinged with red, a quantity of black would be formed by its mixture with the two other primaries, and the green would be tarnished or broken. So long as pure blue and yellow are mixed together, in varying proportions, but without the addition of the other primary color (red), the resulting compound color, green, remains a pure color. Such is the theory, and the practical result is the same if the pigments we select to form the mixture are both free from the third primary.

When the three primaries (pigments) are mixed together in equal strength and proportions, the resulting compound is black. But if they are mixed in unequal

strength and proportions, the mixture is gray. colored by the primary or the secondary in excess in the Compound.

Normal Gray is formed by mixing a black with a white pigment in varying proportions, producing various tones of Gray.

By adding a primary or a secondary to normal Gray, we produce a colored Gray.

There are as many classes of Gray as there are primary and secondary colors, and as many hues of Gray as there are hues of these pure colors. What are commonly called Tertiaries, are, in fact, colored Grays: thus, Russet is red-gray, Citrine is yellow-gray, Olive is blue-gray.

If the primaries are mixed in unequal proportions, or are of different intensities, the mixture is a gray:

If the blue is in excess, the mixture is a blue-gray.

If the red is in excess, the mixture is a red-gray.

If the yellow is in excess, the mixture is a yellow-gray.

If the blue and the red are in excess, the mixture is a violet-gray.

If the blue and the yellow are in excess, the mixture is a green-gray.

If the yellow and the red are in excess, the mixture is an orange-gray.

When two secondaries are mixed together the gray that results is colored by the primary which enters into the composition of both secondaries, thus:

In mixing Green with Violet, the Gray is colored by Blue, that being the primary in excess.

Green consists of Blue and Yellow. Violet consists of Blue and Red.	The compound contains twice as much Blue as Red or Yellow.

In mixing Green with Orange, the Gray is colored by Yellow, that being the primary in excess.

Green consists of Blue and Yellow. Orange consists of Red and Yellow.	The compound contains twice as much Yellow as Blue or Red.

In mixing Violet with Orange, the Gray is colored by Red, that being the primary in excess.

Orange consists of Red and Yellow. Violet consists of Red and Blue.	The compound contains twice as much Red as Blue or Yellow.

It is understood that the colors employed are of equal strength and proportions.

COLORS OF OBJECTS.

The colors of objects are supposed to be due to a power they possess of *absorbing* certain portions of the colored rays that make up a ray of white light, and of *reflecting* others. The reflected portion being complementary to the portion absorbed; and if added together they would constitute white light.

Thus a red-colored substance is considered to absorb blue and yellow, and reflect red.

A green-colored body absorbs red, and reflects blue and yellow,

A white substance, then, in conformity with this view, reflects all the rays that constitute white light, while a black substance absorbs them.

Bodies reflect a considerable portion of white light as well as colored light, according as the surfaces are smooth, glossy, polished, rough, channelled, etc.

The optical effect of a color is greatly modified by the condition of the surface of the colored body; thus, pieces of silk, cotton, linen, woollen, and velvet, although dyed of exactly the same hue and tone of color, appear to be of quite different colors.

The depth or intensity of color presented by velvets, and certain flowers, such as heartsease, etc., is due to the surface being channelled, ridged, or furrowed.

COMPLEMENTARY COLORS.

As white light is composed of three colors, Blue, Red, and Yellow, the color that is missing from the compound is termed the Complementary Color; thus—

Blue is the complementary of Orange (Red and Yellow).

Red is the complementary of Green (Blue and Yellow).

Yellow is the complementary of Violet (Blue and Red).

By this it will be seen that the complementary of a primary color is the secondary composed of the other two primaries, and *vice versa;* thus:

Orange (red and yellow) is complementary to Blue.
Green (blue and yellow) is complementary to Red.
Violet (red and blue) is complementary to Yellow.

If the Blue is tinged with red, its complementary, Orange, will be yellower.

If the Blue is tinged with yellow, its complementary, Orange, will be redder.

If the Red is tinged with blue, its complementary, Green, will be yellower.

If the Red is tinged with yellow, its complementary, Green, will be bluer.

If the Yellow is tinged with red, its complementary, Violet will be bluer.

If the Yellow is tinged with blue, its complementary, Violet will be redder.

CIRCUMSTANCES WHICH MODIFY A COLOR.

A given color, Red, for instance, may experience many modifications, so as to appear very different from what it really is, according to the circumstances under which it is viewed.

It may be modified in its color:

1°. By being placed in contact with Blue, the red appears yellower.

2°. By being placed in contact with Yellow, it appears bluer.

3°. By being placed in contact with Green, it appears purer and brighter.

4°. By being placed in contact with Black, it appears duller.

5°. By being placed in contact with White, it appears lighter and brighter.

6°. By being placed in contact with Gray, it appears brighter.

Thus the same Red may appear many different reds according to the circumstances under which it is viewed

It may also be modified in its intensity, or tone.

Thus, if a dark color be placed beside a different, but lighter color, the dark color appears deeper, and the light color appears lighter. This is the result of contrast of tone.

A color is also greatly modified by gloss, as is shown by the plumage of birds, the wings of butterflies, and by certain flowers.

The colors of objects are also greatly modified by the form of the object, which may produce varieties of light and shade, and thus exhibit many tones of the same color.

Both the tone and the hue of a colored object are modified by the quality of the light by which it is illumined, whether it be direct sunlight, diffused daylight, or diffused reflected light.

MODIFICATIONS PRODUCED IN A COLOR BY BEING PLACED IN CONTACT WITH ANOTHER COLOR.

If we look at two stripes of the same color, but of different tones, or at two stripes of different colors taken at the same tone, and placed side by side, if the stripes be not too wide, the eye perceives certain modifications, affecting both the quality and the intensity of the colors, and they will appear very differently from what they do when viewed separately.

First, the tone of each stripe will appear changed, the light tone will appear lighter, and the deep tone deeper, commencing at the line of contact, where it will be greatest, and gradually diminishing as it recedes from it: this is *contrast of tone.*

Secondly, the color of the different stripes will appear changed, each appearing as differently as possible from the other: this is *contrast of color.*

The contiguous colors are modified in hue, as if the complementary of the neighboring color was added to each.

These modifications, taken together, constitute *simul-*

taneous contrast of color: which may be expressed in the following terms:

Whenever the eye sees at the same time two contiguous colors, they will appear as dissimilar as possible, both in their hue and in their tone.

Thus, if the stripes be blue and yellow, the complementary of blue, which is orange, is added to the yellow, making it appear redder, and more brilliant; while violet the complementary of yellow, is added to the blue, making the latter appear indigo; the color added to each being red, the primary absent from the view of the contiguous stripes. If the stripes be secondary colors, as Orange and Green, the complementary of Orange, *blue*, is added to the green, making it appear bluer, and *red*, the complementary of Green, is added to the Orange, making it appear redder; or, what is the same thing, Yellow, the absent complementary color, is subtracted from each contiguous color; thus—

The complementary of Orange is Blue.
The complementary of Green is Red.
The absent complementary is Yellow.

This Yellow subtracted from Orange makes it appear red, and Yellow subtracted from Green makes it appear blue, for

Orange is composed of red and yellow, and
Green is composed of blue and yellow.

When we look for a few moments at a given color, the eye spontaneously calls up the complementary to that color, which, being added to the color first looked at, makes it appear duller, or tarnished. The effect is the same as if a quantity of gray was added to the color looked at, because the complementary color added to the original color produces black.

This calling up of the secondary color by the eye constitutes the phenomenon of *successive contrast*.

And the addition of this color so called up to the original color constitutes *mixed contrast*.

It will be seen that the result of viewing a single color is different from that produced by viewing two different colors, because the influence of the juxtaposed color is absent; there is no complementary color to add to the color looked at.

The height of tone exercises much influence upon the modification; for if, after looking at orange, we look at deep blue, this latter will appear green rather than violet, a result the reverse of that presented by light blue.

Whenever there is a great difference between two contiguous colors, the difference is rendered more apparent by bringing the same color successively in contact with different colors belonging to the same group.

Example.—If we place Orange beside scarlet-red, normal-red, or crimson-red, the red becomes bluer, or purple, and the orange becomes yellower by losing its red.

If we place normal-red in contact with orange-red, the first will appear purple, and the second yellower; but if we put the normal-red in contact with purple-red, the latter will appear bluer, and the other yellower.

Thus, simple or primary colors, when in contact, pass insensibly into secondary or compound colors; for the same Red becomes purple or orange, according as it is placed in contact with orange-red or with purple-red; the same Yellow appears orange or green, according as it is placed in contact with orange-yellow or with greenish yellow; so also Blue appears green or violet, according as it is placed in contact with greenish-blue or with violet-blue.

When we examine any two patterns of the same color, such as blue or red, if they are not identical when compared together, we must consider that the difference is exaggerated by contrast. Thus, if one is greenish-blue, it will make the other appear less green or more indigo, or even more violet than it really is; and by a reciprocal influence, the other will appear greener than when viewed alone. It is the same with the reds; if one is more orange than the other, the latter will appear more purple, and the former more orange, than it really is.

As soon as we know the complementary of one color in contact with another, it is easy to determine what

kind of modification the second will receive from the first, as this modification is the result of the mixture of the complementary with the contiguous color.

The process is easy when the contiguous colors are both primaries, and it is not more difficult when they are both secondaries; for we have only to consider that the complementary called up being much less intense than the color to which it is added, we obtain the result by subtracting from the latter secondary a portion of that primary which, with the complementary, forms white light; thus—

> Orange, added as a complementary to Green, neutralizes a portion of the green, and consequently makes it appear yellower; and the Green, added to a portion of Red in the Orange, neutralizes it, and makes the orange appear yellower.

RESULT OF PLACING COLORS IN CONTIGUITY.

FIRST GROUP.—TWO COMPOUND COLORS, HAVING THE SAME SIMPLE COLOR IN EACH.

By their reciprocal influence they lose more or less of the color common to both, and will, therefore, differ from each other in proportion to this loss. *Example:*

Orange with Green.

These two colors have yellow as an element in their composition, and they lose it by being placed in contiguity: the Orange appears redder, the Green bluer.

A similar effect takes place with associations of—1, Orange and Indigo, Orange and Violet; 2, Green and Violet, the first of which lose Red by contiguity, and the second lose Blue.

SECOND GROUP.—A COMPOUND COLOR WITH A SIMPLE COLOR WHICH FORMS A PART OF THE COMPOUND.

1. *Orange with Red.*

The Orange loses its red, and appears yellower; and the Red becomes more blue, differing as much as possible from Orange.

2. *Orange with Yellow.*

The Orange loses its yellow, and appears redder; the Yellow appears bluer, differing as much as possible from Orange.

THIRD GROUP.—TWO SIMPLE COLORS.

1. *Red with Yellow.*

Red, in losing yellow, appears bluer, and the Yellow, by losing red, appears bluer; or, in other words, the Red inclines to purple, and the Yellow to green.

2. *Yellow with Blue.*

Yellow, in losing blue, will appear redder, and Blue, in losing yellow, will appear more violet; or, in other words, the Yellow inclines to red, and the Blue to violet.

3. *Red with Blue.*

Red, in losing blue, will appear yellower, and Blue, in losing red, will appear yellowed; or, in other words, the Red inclines to orange, and the Blue to green.

In these examples the colors are modified in the same way they would be by the addition of the absent primary, Yellow.

FOURTH GROUP.—TWO COMPOUNDS COMPOSED OF THE SAME SIMPLE COLORS.

Indigo and Violet.

As Indigo only differs from Violet in containing a larger proportion of blue in comparison with the red, it follows that the difference will be materially increased by the Indigo losing its red and inclining to greenish-blue, whilst the Violet, acquiring more red, will become redder.

FIFTH GROUP.—A COMPOUND COLOR, AND A SIMPLE COLOR WHICH IS NOT FOUND IN THE COMPOUND.

1. Orange and Blue.
2. Green and Red.
3. Violet and Greenish-yellow.

In opposing complementary colors, each enhances the value of the other, in conformity with the phenomena of successive and mixed contrasts.

INFLUENCE OF GLOSS AND OF FORM UPON THE EFFECT OF CONTRAST OF TWO COLORS.

The form of an object, and its gloss or polish, have a considerable influence upon the effect of associated or contiguous colors. Form exerts its influence by the effects of light and shade it produces, which may conceal the ill effect of two associated colors, which are not glossy. Thus, flowers often exhibit associations which on plane surfaces would appear very disagreeable, if not glossy; as, for instance, in the sweet pea, in which red and violet are associated.

Blue and violet, which have not an agreeable effect on flat and unpolished surfaces, have a very good effect in the plumage of certain birds, and in the wings of butterflies. For the injurious effect of the complementaries of these two colors upon each other is lost through the influence of the metallic lustre of the feathers and scales.

BINARY ASSOCIATIONS OF COLORS.

1. ASSOCIATION OF COMPLEMENTARY COLORS.

This is the only association in which the colors mutually improve, strengthen, and purify each other, without going out of their respective scales.

This condition is so advantageous to the associated colors that the association is also satisfactory when the colors are not exactly complementary.

It is the same when they are tarnished with Gray.

Therefore this association is the best that can be adopted to produce harmony of contrast in painting, in tapestry, stained glass windows, between paper hangings and their borders, in furniture and clothing, and in flower-gardens.

2. ASSOCIATION OF NON-COMPLEMENTARY COLORS.

The result of this association differs from the preceding in this respect—the complementary of one of the colors differing from the other color to which it is added, causes a modification of *hue* in the two colors, besides a modification of *tone*, if they are not taken at the same intensity.

Non-complementary colors evidently produce three different effects when placed in contact.

1°. They mutually improve each other.

2°. One is improved while the other is injured.

3°. They mutually injure each other.

The greater the difference between the colors the more their association will be favorable to their mutual contrast; and the nearer they are alike, the greater the risk their association will prove injurious to their beauty.

a. Two Non-Complementaries improve each other by Association.

Ex. Yellow and Blue are so dissimilar, that their contrast is sufficiently great to produce a favorable association, although the associated colors belong to different scales of yellow and blue.

b. One Color, placed in Contact with another Color which is not complementary to it, is improved, but the other is injured.

Ex. A Blue, which is improved by yellow, being placed beside bluish Violet, may lose beauty by becoming greenish, while the orange it adds to the violet, neutralizing its excess of blue, improves rather than injures it.

c. Two Non-Complementary Colors mutually injure each other.

Ex. A Violet and a Blue mutually injure each other, because the first makes the second look green, and the second neutralizes the blue of the violet and makes it look faded.

It may happen that the colors are modified, but neither gain nor lose in beauty; or that one gains without the other losing, and that one neither gains nor loses, while the other loses.

IN THE ASSOCIATION OF TWO COLORS OF EQUAL TONE, THE HEIGHT OF THE TONE MAY INFLUENCE THE BEAUTY OF THE ASSOCIATION.

Ex. A deep indigo-blue, and an equally deep red, gain by contact: the blue by losing violet, will become pure

blue; the red, acquiring orange, will become brighter. But if we take light tones of the same scales, the blue may become too green to be good as a blue, and the red, by acquiring orange, may become too yellow to be a good red.

In the association of two colors belonging to the same scale, or to scales nearly allied, but of tones very widely apart, the contrast of tone may have a favorable influence upon the beauty of the light tone:

Because, if the latter is not a pure color, its association with the deep tone brightening it, will purify what gray it has.

INFLUENCE OF THE CONTIGUITY OF WHITE ON COLORS.

White substances contiguous to colored substances appear sensibly modified when viewed together, although the modification may not be very apparent unless we are familiar with the law of contrast; but knowing this law, the modification may be recognized if the colors opposed to the white be not too deep. Thus: if red and white are placed in contact, the white becomes tinged with the complementary of red, which is green, and makes the red appear deeper and brighter.

Black and white, which may be considered as complementary to each other, conformably to the law of contrast of tone, differ more when viewed in contact than when alone, because the effect of the white light reflected by the black is more or less neutralized by the light of the white stripe; and it is by an analogous action that white heightens the tone of the colors with which it is placed in contact.

All the primary colors gain by association with white, but the resulting binary assortments are not all equally agreeable; the height of tone of the color has a great influence upon the effect of its assortment with white, thus—

Light blue and light red assort better with white than dark blue and dark red, because the latter present too great a contrast of tone.

White placed beside a color strengthens its tone; it

acts as if we took away from the color the white light that enfeebled its intensity.

INFLUENCE OF THE CONTIGUITY OF BLACK ON COLORS.

A black surface being deeper than the color with which it is in contact, contrast of tone must tend to deepen it still more, while it must tend to lower the tone of the contiguous color, for exactly the same reason that white, if in contact with it, would heighten it.

Black surfaces appear tinted with the complementary of the colored light of the contiguous body; but the tint will be very faint, because it is manifested upon a ground possessing but a feeble power of reflecting light.

The lowering of the tone of a color in contact with Black is always perceptible; but it is very remarkable that the Black itself is weakened when the contiguous color is sombre, yielding a luminous complementary.

Black may be advantageously combined not only with sombre colors to produce harmonies of analogy, but also with light and brilliant colors to produce harmonies of contrast, as may be seen in the works of Chinese artists.

No assortment of the primary colors with Black is disagreeable, but a generic difference of harmony exists between these assortments, which is not presented in the same degree in the binary assortment of the same colors with white. For the splendor of the white is so dominant in the latter, that whatever be the difference in light or brilliancy observable between the different colors associated, there will always be harmony of contrast.

The deep tones of all the scales, and even of the Blue and Violet scales (which, strictly speaking, are not deep), form with Black harmonies of analogy and not of contrast. So also do the unbroken tones of the Red, Orange, Yellow, Green, and the very light tones of the Violet and Blue scales.

The association of Black with sombre colors, as Blue and Violet, the complementaries of which, Orange and Greenish Yellow, are luminous, may diminish the contrast of tone, if the colors are in contiguity with Black, or not

very distant; in this case the Black loses much of its vigor.

Black placed beside a color lowers its tone; it acts as if we added Black to the complementary of the contiguous color. In some cases it impoverishes it, as in the case of certain yellows.

The modifications Black patterns undergo upon different colored grounds, are as follows:

Upon a Red ground, they appear Dark Green.
Upon an Orange ground, they appear Bluish-Black.
Upon a Yellow ground, they appear Black, of a feeble Violet tint, on account of the great contrast of tone.
Upon a Green ground, they appear Reddish-Gray.
Upon a Blue ground, they appear Orange-Gray.
Upon a Violet ground, they appear Greenish Yellow Gray.

INFLUENCE OF THE CONTIGUITY OF GRAY ON COLORS.

Gray bodies properly selected as to height of tone, when contiguous to colored bodies, exhibit the phenomena of contrast of color more strikingly than either black or white substances do.

If, instead of normal gray, we placed a colored body in contact with a Gray of a complementary tint, these tints will be remarkably heightened by the complementaries added to them by the colored bodies. Thus, if an orange color be placed on a bluish-gray, this latter will be singularly heightened with blue, the complementary of orange.

All the primary colors gain in purity and brilliancy by the proximity of gray; but the effects are far from being similar, or even analogous to those which result from the proximity of the same colors with white. White allows each color to preserve its integrity, and even heightens them by contrast, and can never be taken for a color itself. But Gray can; for with the darkest colors, as Blue and Violet, and with the deep tones in general, it produces associations which enter into analogous harmonies, while with the brilliant colors,

as Red, Orange, Yellow, and the light tones of Green they form harmonies of contrast. Although White contrasts more with the sombre colors than with the luminous, there is not the same difference between White and these two classes of colors as there is between them and Gray.

The *ground* as well as the *interval* or distance we make between the colored bodies, has some influence on the effect.

HARMONY OF COLORS.

There are six distinct Harmonies of Colors, which may be comprised under two groups:

FIRST GROUP.—HARMONIES OF ANALOGOUS COLORS.

1°. Harmony of scale, proceeding from the simultaneous view of different tones of a single scale, more or less approximating.

2°. Harmony of hues, proceeding from the simultaneous view of tones of nearly the same height, or nearly so, belonging to scales more or less approximating.

3°. Harmony of a dominant colored light, proceeding from the simultaneous view of different colors assorted conformably to the law of contrast, but one of them predominating, as if they were seen through a glass stained with a faint tone of that color.

SECOND GROUP.—HARMONIES OF CONTRAST.

1°. Harmony of contrast of scale, arising from two distinct tones of the same scale.

2°. Harmony of contrast of hues, arising from tones of different heights, each belonging to contiguous scales.

3°. Harmony of contrast of colors, arising from the simultaneous view of colors belonging to widely different scales, assorted according to the law of contrast; the difference in height of juxtaposed tones may also augment the contrast of color.

1. In the harmony of contrast, the complementary assortment is superior to every other; the tones must, however, be nearly of equal intensity.

2. The primaries grouped in pairs assort better as a harmony of contrast than an arrangement formed of one

of these primaries and a binary of which that primary is an element, thus—

Blue and Yellow harmonize better than Red and Orange, because the binary Orange contains Red as one of its elements.

Red and Blue harmonize better than Red and Violet, because the binary Violet contains Red as one of its elements.

Yellow and Red harmonize better than Yellow and Orange, because the binary Orange contains Yellow as one of its elements.

3. The assortment of red, yellow, and blue with a binary containing the primary, contrasts better when the primary is more luminous than the binary.

Therefore, in this assortment, it is better for the primary to be of a lower tone than the binary, thus—

Red and Violet harmonize better than Blue and Violet.

Yellow and Orange harmonize better than Red and Orange.

Yellow and Green harmonize better than Blue and Green.

4. When two colors do not look well together, separate them with white. It is better for the white to be placed between each color than between every two colors.

5. Black never produces a bad effect when placed between two luminous colors, and is, therefore, often preferable to white for separating colors from each other, thus—

Red and Orange do not go well together, but if separated by black an agreeable and harmonious effect is produced.

6. Black harmonizes with sombre colors, Blue and Violet, and with broken tones of luminous colors produces harmony of analogy sometimes with a good effect.

7. Black does not associate so well with a luminous and a sombre color, as it does with two luminous colors.

In all the following assortments Black is inferior to White.

Red and Blue, Orange and Blue.

Red and Violet, Orange and Violet.
Yellow and Blue, Green and Violet.
Green and Blue.

8. Although Gray does not produce a bad effect with two luminous colors, yet it is generally inferior to Black and to White.

9. Gray with sombre colors and broken tones of luminous colors produces harmonies of analogy, not so vigorous as those with black.

It separates colors which do not assort well together.

ON THE SELECTION OF THE KIND OF HARMONY FOR A GIVEN OBJECT.

In proceeding to the selection of an assortment of colored objects, we have to take into consideration suitability or appropriateness to the object in view.

Where the greatest brilliancy and splendor are desired, we resort to the contrast produced by complementary colors. In the selection of flowers to form a bouquet, or the furnishing of a palace, the principle is the same; we arrange the colors so that the greatest contrast both in tone and in the quality of the colors employed is produced.

Any one familiar with the law of Contrast will attain this aim with better success, even with inferior colors, than another ignorant of the law could obtain with the most brilliant colors.

But where the artist is free to choose, he will consider the aspect of the apartment, and whether it is to be used by daylight or artificial light A room with a cold northern aspect, used in the daytime, should be furnished with objects of light warm tones; while in a room with a southern aspect, light hues of sombre colors may be advantageously employed.

He must never lose sight of the effect of contrast of tone. Thus, in a room papered with the deep crimson paper so commonly employed, the tone is so deep, that it forms a strong contrasting background to all light-colored objects placed in it; but dark-colored objects are lost for want of relief. In such a paper, contrast of color goes almost for nothing, as a blue or a green

paper, of the same depth of tone, would produce near the same effect.

In rooms that are feebly lighted, and chiefly by diffused daylight, light tones of sombre colors, or luminous colors, are preferable for covering the walls; but then other colored portions of the fittings should be colored in analogous harmony, and violent contrast avoided.

In undertaking to apply the principles laid down by M. Chevreul, most persons overlook the importance of *tone*, or intensity, but which is of equal importance with color. A deep tone of a bright peagreen, of an orange, or of a red, may produce a very crude, vulgar effect, when light tones of the same colors would do the contrary.

Very pleasing effects may be produced by adopting the Harmony of Analogous Colors.

Suppose a room to be furnished in blue, or red, or green, we may proceed with all the tones of one hue of green, for instance, or mingle the tones, of nearly equal intensity, of the various blue and yellow greens that lie on each side of pure green. The distribution of these in the room will require careful consideration, but probably the most satisfactory effect will be attained by taking the lightest tones and brightest hues for the walls, and the deepest for the carpet. The color of the wood for the chairs, etc., will contrast sufficiently to secure distinct relief. The curtains and the furniture may be of intermediate quality of color, and the effect will be greatly enchanced by the introduction of white.

The artist must not omit to take into consideration the influence of form, size, and suitability, when proceeding to carry out the principles of Contrast.

INDEX.

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